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M E M O R A N D U M

June 8, 2006

TO: Michael Thabault

FROM: Bruce Kiely

RE: E-mail Dated May 11, 2006

On April 18, 2006, Weaver's Cove Energy, LLC ("Weavers Cove") met with representatives of the Department of the Interior, U.S. Fish and Wildlife Service, National Park Service ("DOI contingent"), USACE, and NOAA to discuss the February 7, 2006, letter from FWS to USACE ("February 7 Letter"). Distilled to its essence, that letter stated that unless additional time-of-year ("TOY") dredging restrictions extending to October 31 were imposed on proposed dredging in the lower Taunton River, the USACE should deny Weaver's Cove's dredging permit application. In the February 7 Letter, FWS/NPS concludes:

> We recommend a time-of-year restriction of March 1 – July 31 for the protection of the incoming anadromous fish migration. To adequately protect the downstream migration, we continue to recommend a time-of-year restriction of July 1 through October 31. If this is unacceptable, we recommend that no dredging take place upstream of the I-195 bridge from July 1 to October 31 . . . As currently proposed, the dredging for this project would have unacceptable adverse impacts to the anadromous fishery resources in the Taunton River. Without time-of-year restrictions for both upstream and downstream migrations, we continue to recommend that this application be denied.

At the April 18 meeting, Weaver's Cove challenged the findings and conclusions of FWS in the February 7 Letter because, among other things, (1) they are not supported by any scientific evidence in the record as of the date of that letter, (2) the location of the proposed dredging is not within a Wild and Scenic River Act ("WSRA") study area giving FWS/NPS no legal authority under the WSRA to dictate TOY restrictions on dredging, and (3) the proposed dredging is not a "water resource project" and thus is not covered by the WSRA. Weaver's Cove offered a balanced proposal as to the TOY restrictions which provided, to the benefit of FWS/NPS, far more restrictions than the scientific evidence in the record at the time of the February 7 Letter would support and, for the benefit of Weaver's Cove, fewer restrictions than the February 7 Letter would require.

The DOI contingent at the April 18 meeting asked for time to assess the situation, to assess the facts in the record, and to address the Weaver's Cove compromise proposal.

By e-mail dated May 10, 2006, but received on May 11, 2006 ("May 10 e-mail"), FWS advised Weaver's Cove that the Weaver's Cove "Dredging Program Report," ASA Modeling Report and some unidentified background information had been reviewed and provided what were called "comments." We later received the documents on which the e-mail relied and then received on May 25, 2006 the page references on which the e-mail was based.

Weaver's Cove has reviewed the e-mail and has several observations:

1. Since the May 10 e-mail contained no references to the February 7 Letter and since that e-mail provided no information from the record as it existed on February 7, 2006, Weaver's Cove is left to assume that the DOI contingent was not able to find any evidence in the record as of February 7 to support the conclusions in that letter.

2. Your May 10 e-mail contains no discussion of Weaver's Cove's proposed compromise as to the TOY restriction on dredging.

Weaver's Cove is left to conclude that the response of the DOI contingent to Weaver's Cove's proposal as to TOY restrictions is done of rejection without discussion. Apparently it is the position of the DOI contingent that dredging the lower Taunton is governed by the WSRA study of the upper Taunton authorized by Congress and that the term "no adverse effect" in the context of the Weaver's Cove project effectively means "no effect." We do not believe those positions will survive judicial scrutiny.

If that is the conclusion the DOI contingent intends to convey, please advise us, as any further meetings or exchange of information would then appear futile.

Notwithstanding its position that the extensive TOY restrictions sought by the DOI contingent are without scientific basis, Weaver's Cove remains willing, as it has been from the inception of this project, to work with the DOI contingent to arrive at reasonable, science-based TOY restrictions. We therefore provide as Attachment 1 our analysis of and response to the assertions made in the e-mail. For ease of reading, the e-mail wording is shown in regular type and Weaver's Cove's responses are in bold. In addition, in the hope of bringing this debate on TOY restrictions to a close, we provide as Attachment 2 a comprehensive proposal on fish protection issues, including proposed mitigation measures.

After you have had a chance to review this e-mail, please call so we can determine whether a further meeting is in order.

Attachments

cc: Marvin Moriarty
Ted Barten
Deborah French-McCay
Ted Gehrig

Attachment 1

Weaver's Cove Response to 10 May 2006 and 25 May 2006 DOI E-Mails from Vern Lang

WEAVER'S COVE RESPONSE TO
10 MAY 2006 AND 25 MAY 2006 DOI E-MAILS FROM VERN LANG

(For ease of reading, the e-mail text is in regular print and the Weaver's Cove response is in bold print)

June 8, 2006

10 May 2006 email:
As follow-up to our April 18, 2006 meeting regarding the Weaver's Cove Energy Project, we have reviewed the Dredging Program Report, ASA Modeling Report and background information and offer the following comments.

"As you know, the effects threshold under the Wild and Scenic Rivers Act (WSRA) is clear, i.e., there shall be no adverse impact to the values for which the Taunton River may be included in the National Wild and Scenic River System. ... For purposes of the Weaver's Cove Project review, effects thresholds that cause a behavioral response to suspended sediment such as avoidance are included in the category of adverse effects."

Weaver's Cove's Response:
As a threshold matter, Weaver's Cove does not agree that the assertion above reflects the law nor does it even reflect the DOI/FWS/NPS position articulated in the February 7 Letter from the FWS to USACE. According to that letter, Section 7(b) of the WSRA states "... no department or agency of the United States shall assist by loan, grant, license or otherwise the construction of any water resources project that would have a direct and adverse effect on the values for which such river might be designated ... nothing in the foregoing sentence, however, shall preclude licensing of, or assistance to, developments below or above a potential wild, scenic or recreational river area ... which will not invade the area or diminish the scenic, recreational and fish and wildlife values present in the potential wild, scenic or recreational river area." As this quoted statutory language makes clear, the reference in the May 10 e-mail to an "effects threshold" of "no adverse impacts" confuses the standard applicable to a study river versus a development below or above a study river.

We also note that the February 7 Letter only talks about the significance of anadromous fish resources. It does not address estuarine fish as incorrectly asserted in the May 10, 2006 e-mail.

Further, in the May 10 e-mail, DOI/FWS/NPS appears to be creating its own, more exacting standard for Weaver's Cove. The notion of an environmental impact review standard of "effects thresholds that cause a behavioral response" simply does not square with the statutory standard of "direct and adverse effects".

Furthermore, the Taunton River Stewardship Plan (July 2005 draft), Fisheries section, states that the value of the upper Taunton is based primarily on the nature of the habitat (repeated references to the undammed river runs with good fishing habitat), not the specific number of fish observed passing through the river over a period of several years. Specifically, the Stewardship Plan states: (1) "The Taunton River is the longest undammed coastal river in New England".... (2) "Currently dams limit or eliminate access to spawning habitats on some tributaries, but there is huge potential for the restoration of species such

as herring, shad and rainbow smelt through selective dam removal".... (3) "The quantity of freshwater habitat and absence of deadly hydroelectric dams from the entire watershed make the Taunton River critical habitat for these threatened migratory fish".... (4) "The Taunton River is extremely important in providing foraging, nursery and migratory habitat for many species of fish" (pages 36-38). Nothing in the May 10 e-mail or the prior comment letters of DOI/FWS/NPS in the permitting record demonstrates that the proposed dredging work will have any effect whatsoever on any of these listed habitat values in the upper Taunton, the only section of the river formally authorized for study by Congress. The lower Taunton, the segment of the river adjacent to the terminal, has not been authorized by Congress for study.

This response does not address the other threshold issue, namely does DOI/FWS/NPS have any authority under the WSRA to issue any binding recommendations as to time-of-year restrictions for the Weaver's Cove Project. Weaver's Cove has addressed this issue fully in the permitting record.

Effects Thresholds

<u>10 May 2006 e-mail</u>:
Weaver's Cove Energy has utilized an effects threshold of 600 mg/l suspended sediment for adult and juvenile fish, 200 mg/l for larvae, and 100 mg/l for fish eggs (70 mg/l for w. flounder) (Table 5.6 in the ASA Modeling Report 02-200). Our analysis indicates that these values are 1-2 orders of magnitude under protective for the Taunton River situation. As you know, the effects threshold under the Wild and Scenic Rivers Act (WSRA) is clear, i.e., there shall be no adverse impact to the values for which the Taunton River may be included in the National Wild and Scenic River System. Diadromous and estuarine fish, including winter flounder, white perch, rainbow smelt, alewife, blue back herring, American eel, American shad, coastal brook trout, and other species of aquatic life comprise the aquatic life values of the Taunton River.

<u>Weaver's Cove's Response:</u>
The issue is the potential for impact to migratory (diadromous) species, which both use the upper Taunton River in the area being studied for Wild and Scenic River status (which is freshwater) and the Weaver's Cove dredging area (which is estuarine), during the general period of downstream migration between August 1 to October 31. No other species of aquatic life occurs in both areas.

Most of the species cited by DOI are not included in the list of those that migrate down the Taunton River between June and the end of November. Of these species, the only ones that are included in the list, as provided by Massachusetts Division of Marine Fisheries (MDMF) in their 9 December 2005 memo to MEPA Secretary Stephen Pritchard, are alewife (mid-June through November) and blue back herring (September through early November).

Coastal brook trout would not be found in areas as far downstream as the proposed dredging, and so could not be impacted. They have never been impinged on the Taunton River intake screens at Brayton Point Station or the intake screens at Somerset Station (Mike Scherer, Marine Research Inc., personal comm. May 2006). They were also not reported in Taunton River fisheries studies completed upstream by Bridges (1955), Curley et al. (1974), Madore (1976), Hurley (1990), MRI (1992), and Buerkett and Kynard (1993).

Winter flounder and other estuarine-marine species of aquatic life do not occur in the area of the Taunton River being studied for Wild and Scenic River status, and similarly could not be impacted. Accordingly, most of this long list of fish are not relevant to the TOY restriction from July 31 to October 31. Finally, we note again that the formal position of DOI/FWS/NPS in the February 7 Letter was limited to anadromous fish.

10 May 2006 e-mail:
For purposes of the Weaver's Cove Project review, effects thresholds that cause a behavioral response to suspended sediment such as avoidance are included in the category of adverse effects. These effects thresholds correspond to severity of ill effect levels (SEV) 1-3 or higher based on Newcombe and Jensen (1996). Avoidance of the suspended sediment plume could delay or abort migratory movements, increase the channeling of fish into zones where they would be subject to increased predation, cause fish to attempt to move around the edge of the plume closer to the shoreline and enter intake/discharge zones, or cause other adverse effects depending on the species/life stage involved.

Weaver's Cove's Response:
For perspective, Weaver's Cove would invite DOI/FWS/NPS to review the scale of severity (SEV) of ill effects associated with excess suspended sediment.

Scale of the severity (SEV) of ill effects associated with excess suspended sediment (Table 1 [page 694] in Newcombe and Jensen [1996])

SEV	Description of Effect
	Nil Effect
0	No behavioral effects
	Behavioral effects
1	Alarm reaction
2	Abandonment of cover
3	Avoidance response
	Sublethal effects
4	Short-term reduction in feeding rates; short-term reduction in feeding success
5	Minor physiological stress; increase in rate of coughing; increased respiration rate
6	Moderate physiological stress
7	Moderate habitat degradation, impaired homing
8	Indications of major physiological stress; long-term reduction in feeding rate; long-term reduction in feeding success; poor condition
	Lethal and paralethal effects
9	Reduced growth rate; delayed hatching; reduced fish density
10	0-20% mortality; increased predation, moderate to severe habitat degradation
11	>20-40% mortality
12	>40-60% mortality
13	>60-80% mortality
14	>80-100% mortality

In the ASA modeling report and below you will find support for Weaver's Cove's assertion that the effects thresholds used in the modeling are conservatively low and appropriate for the limited extent and short duration of exposure to suspended sediments that would occur

during dredging (dredging is not a point source discharge that is in one location for decades).

The reference in your May 10 e-mail to and your reliance on Dr. Charles Newcombe are helpful. Dr. Charles Newcombe has read the ASA Weaver's Cove report, and has stated, in a 2 February 2004 e-mail communication with Chris Powell (Rhode Island Division of Fish and Wildlife), that it is "well thought out and well written" and that "in all respects it is exemplary." Dr. Newcombe did not express any reservations or concerns about the effects thresholds that we used in our modeling.

10 May 2006 e-mail:
Smelt and brook trout are among the most sensitive group of fishes to suspended sediment (Newcombe and Jensen 1996; Wilber and Clarke 2001). Newcombe and Jensen give brook trout an SEV rating of 3 (avoidance response) for a 4.5 mg/l exposure duration of 168 hours to suspended sediment based on a study by Gradall and Swenson (1982). Newcombe and Jensen give rainbow smelt an SEV score of 7 (impaired homing) for a 3.5 mg/l exposure duration of 168 hours based on a study by Swenson (1978). Newcombe and Jensen give trout (species not listed) an SEV rating of 4 (short-term reduction in feeding rate) for a 16.5 mg/l exposure duration for 24 hours based on information by Townsend (1983) and Ott (1984). Brown trout and rainbow trout, close relatives to brook trout, are given an SEV rating of 10 (0-20% mortality) for an 18 mg/l exposure duration of 720 hours (30d), based on a study by Peters (1967), as cited in Newcombe and Jensen (1996).

Weaver's Cove's Response:
While two isolated brown trout have been collected in the saline waters at the Brayton Point intake screens (one in 1976 and another in 1998) and brown trout were listed as being collected in the Taunton River in the 1970's (Madore, 1976), the chance of a trout being near the proposed dredging is extremely low (Mike Scherer, Marine Research Inc., personal comm. May 2006). Thus, laboratory data using trout, which are generally found in clear freshwater streams and rivers, (not estuaries like the lower Taunton River) cannot credibly be deemed relevant to the impact evaluation of the proposed Weaver's Cove dredging. In addition, the brook trout citation given in the May 10 e-mail here is for a study on red clay turbidity in freshwater, which is not relevant to exposures (to silt, sand and small percentages of clay) in the estuarine study area of concern.

With respect to rainbow smelt, there is no indication that they migrate down the Taunton River during the period of concern (August 1 to October 31). Smelt have been collected on the intake screens at Brayton Point every year between December and April, and most have been collected in March (Mike Scherer, Marine Research Inc., personal comm. May 2006).

Based on research done north of Cape Cod, smelt eggs appear the first week of March and spawning ends by early May (Mike Scherer, Marine Research Inc., personal. comm. May 2006). Smelt eggs typically hatch in 10-21 days, and upon hatching larvae are immediately transported downstream into the tidal zone to begin feeding on zooplankton (Chase and Childs, 2001). Therefore, there is no evidence that smelt would be expected to be in the area of the Weaver's Cove dredging during the period at issue, July 31 to October 31.

In addition to the established fact that brook trout would not be present at all and rainbow smelt would not be migrating down or in the Taunton River project area between the end of July and the end of October, it should be noted that the duration of exposure is critical in determining the level of effect on any species (Wilber and Clarke, 2001). For instance, concentration alone correlated poorly with responses of salmonid fish to suspended sediments, whereas dosage (measured as mg h L^{-1}) was more strongly associated with fish responses (Newcombe and MacDonald, 1991 as cited in Wilber and Clarke, 2001). Dosage is a function of both concentration and duration of exposure. In general, the longer the duration and greater the exposure, the more severe the effects (Berry et al., 2003). As stated by Berry et al. (2003), it is expected that as the duration of exposure and intensity of exposure increase, sub lethal effects are manifested, and lethal effects would begin to be expressed at more intense exposures of longer duration.

While the exposure durations for the species listed above are on the order of 168-720 hours (7 to 30 days), this would not be the case in the proposed dredging plan where the dredge is moving over time and the area potentially affected changes with each tide. The peak excess concentrations of suspended sediment from dredging at maximum sediment removal rates are predicted to (1) be very low, (2) occur temporarily (only for 1 hour during times of slack tide when the sediment load affects the same portion of water and the concentration builds); (3) occur over a limited area, and (4) occur only just above the bottom sediments (observations of dredging operations have shown the highest concentrations at or near the bottom due to the impact of the dredge bucket). In addition, the dredge will not operate at maximum sediment removal rates throughout the dredging program, as the dredge cannot dredge while it is being repositioned nor while full scows are being moved out and empty scows are being moved into position near the dredge. Thus, the data cited in the May 10 e-mail are simply not relevant to the analysis of the potential impacts of the proposed dredging.

10 May 2006 e-mail:
Chiasson (1993) reports that smelt showed an alarm response (increased swimming behavior) at suspended sediment concentrations of 10 mg/l and above. The alarm response has an SEV score of 1. Wildish and Power (1985) identified a threshold effect for smelt (avoidance response) at a suspended sediment concentration between 18.8 and 21.8 mg/l. This response has an SEV score of 3.

Weaver's Cove's Response:
There are several reasons why the results suggested in the assertion above do not indicate that rainbow smelt or any other anadromous species would be negatively affected by suspended sediments in this range. First, the most compelling reason why suspended sediments of 10-40 mg/L should not cause sub lethal effects on migrating anadromous fish is that the background concentrations in the Taunton River, as in typical northeast estuaries, average between 8 and 11 mg/L and concentrations during storms typically are in the range of 10-40 mg/L. (Boucher, 1991; Stella Tamul, MA DEP, Division of Watershed Management, personal comm., February 2006). The maximum concentrations observed during any storm period in any study was 84 mg/L, with a rapid return (12-18 hours) to pre-storm conditions (Turner et al., 1990).

Thus, all the anadromous species using the Taunton River are routinely exposed to suspended sediment concentrations in the range of 10-40 mg/L and substantially higher

during rain events. TSS is not particularly high or variable because the river watershed has relatively little readily reodable material left from the scouring effects of the extensive glaciation of the region (Postma, 1980). There is no reason to believe that the temporary localized plumes from dredging in this same concentration range and over the same time scale of hours (and far more localized in the case of the dredging) would have any different effect on anadromous species than do storm-induced plumes. It is possible that anadromous species behavior is affected by storm-induced plumes, but the species have evolved to successfully migrate up and down the Taunton River with these conditions present, just as they have done in many other rivers.

Second, as noted by Wildish and Power (1985), there may be bias in their laboratory results such that they cannot be applied to the field. The observations were simply that in the laboratory apparatus the fish swam faster in the water containing more suspended sediment than was where the water contained lower concentrations of sediment. Wildish and Power suggest the need for field studies where other behaviors, such as migration and escape movements, could be evaluated to determine if these behavior might "override the avoidance movements" observed in their laboratory tests and laboratory equipment. Similarly, Chiasson (1993) states that because of the nature of the experimental conditions used in the study, extrapolating these results to the field is questionable.

Lastly, this same reaction of increased swimming speed is common when the fish are feeding or prey are present in the water (Durbin et al., 1981; Macy et al., 1999; Andrew et al., 2002; Marchard et al., 2002). Satiation and current velocity can also play a part in fish swimming behavior (Asaeda et al, 2001; Hinch and Rand 2000; McFarland and Levin 2002). Therefore, the causes and implications of changes in swimming behavior are complex and observed bursts of swimming activity are a normal behavior fish undergo naturally. Thus, the assumption based on laboratory experiments that either observed increases in swimming speeds and/or preference for lower turbidity indicates an adverse effect in the field is unfounded.

10 May 2006 e-mail:
Johnston and Wildish (1981) found that Atlantic herring, a clupeoid fish related to the alosids, showed a reduced feeding rate at a suspended sediment concentration of 20 mg/l exposure duration of three hours. In a 1982 study, these authors found that juvenile Atlantic herring exhibited an avoidance response to a 9-12 mg/l exposure duration of three hours. These responses have SEV scores of 4 and 3, respectively.

Weaver's Cove's Response:
The statement as to Atlantic Herring is not relevant here. Atlantic herring is not among the species that migrates between the area where dredging is proposed and the upper Taunton River area being investigated for Wild and Scenic River status. In fact, Atlantic herring are "sea herring", as opposed to "river herring" such as alewife and blueback herring. Atlantic herring spend their lives in coastal marine areas and never migrate to freshwater (John Torgan, Save the Bay, http://narragansettbaykeeper.blogspot.com/2006_02_01_narragansettbaykeeper_archive.html, May 2006). Adult Atlantic herring make extensive seasonal migrations between summer spawning grounds on Georges Bank and in the Gulf of Maine and over wintering areas in southern New England and the Mid-Atlantic region ocean waters (Stevenson and Scott, 2005).

We also note that the citations for the two Johnston and Wildish papers are reversed. The Johnston and Wildish (1981) paper is actually the Johnston and Wildish (1982) paper, and vice versa. Johnston and Wildish (1982) is a study on larval herring, not juvenile herring as stated in the May 10 e-mail. Since Atlantic Herring are not in the area and do not migrate through the area, larval and juvenile Atlantic Herring are also not found in the area.

10 May 2006 e-mail:
Berry et al. (2003) report that adult hard clams (*Mercenaria mercenaria*) showed a reduced growth response to a suspended sediment concentration of 27 mg/l exposure duration of 14 days based on a study by Murphy (1985). Berry et al. (2003) report that juvenile hard clams show a reduced growth response to a 44 mg/l exposure duration of 21 days based on a study by Bricelj et al. (1984). Both of these responses have an SEV score of 9 (reduced growth rate).

***Weaver's Cove's Response*:**
These statements above are not relevant to the issue of whether dredging during the period July 31 to November 30 could impact migratory fish.

Hard clams only exist in saltwater estuarine areas; they are not found in the freshwater environment of the upper Taunton.

Further, the data reflected in the May 10 e-mail relate to long durations of exposure, which are 14 days and 21 days, respectively, for adult and juvenile hard clams in the studies described above. In sharp contrast, the dredging would produce localized concentrations of this order for only about an hour, and not for days. Wilber and Clarke (2001) showed that aquatic biota can tolerate relatively high suspended sediment concentrations when exposure duration is brief.

10 May 2006 e-mail:
General Response to DOI's assertion that dredging should not occur during the migratory fish down-stream migration period.

Weaver's Cove's Response:
The DOI reviewed the DEIS for the Providence River dredging project and the record does not indicate that DOI made any comments that the downstream migrations of the same diadromous species would be impacted by dredging. Thus, it is inconsistent (and there is no evidence to support) DOI/FWS/NPS's change in their opinion from one of no comment to one where potential impacts from dredging become the rationale for severe dredge restrictions to protect downstream fish migrations. In all five segments of the Providence Project, dredging was allowed to occur from August 1 to January 31 with no mention of potential impacts on downstream migrating diadromous fish (USACE, 2001).

For the Providence Project, dredging restrictions were limited to winter flounder (February – April) in two of five project segments and a short shellfish spawning restriction in one segment.

Noise threshold

10 May 2006 e-mail:
Fish, particularly the clupeoid fishes (e.g., alewife, herring, American shad, white perch) are known to respond to the sounds made by boats, dredges, and other man-made facilities (Wilson and Dill 2002). The effects of the construction and operational noises from this project on acoustically-sensitive fish species have neither been discussed nor evaluated. To our knowledge, Weaver's Cove Energy has not identified which species of fish besides the clupeoids identified here, or other aquatic life are acoustically sensitive to the range of sounds that would be emitted from the Project. Nor have they identified the range and characteristics of the sounds that would be produced. Connor et al. (2005) state that short duration, low frequency sounds tend to produce startle responses in Pacific and Atlantic herring, while longer duration, high frequency sounds produce avoidance responses such as compacting the school, sinking in the water, or leaving the area.

Weaver's Cove's Response:
Again, the issue with respect to the DOI/FWS/NPS suggested ban on dredging through October 31 reflected in the February 7 Letter to USACE is the potential for impact to migratory (diadromous) species, which both use the upper Taunton River in the area being studied for Wild and Scenic River status (which is freshwater) and the area where dredging would occur for the Weaver's Cove Project (which is estuarine), during the general period of downstream migration between August 1 to October 31.

Various species of anadromous fish show avoidance responses when subjected to high-frequency sounds (~100-180 kHz). There have been a number of studies investigating this response in relation to mechanisms to deter anadromous fish from entering hydroelectric turbines (Dunning, et al., 1992; Gibson and Myers, 2002; Nestler, et al., 1992). However, low frequency sound (<1000 Hz), possibly mimicking "sounds of predation", can also elicit strong avoidance responses in prey fish such as alewife. The number of alewife entering an experimental structure was reduced by 71% - 99% when low frequency sound-emitting poppers were operating (Haymes and Patrick, 1986). There is evidence that sound pressure levels (intensity), rather than frequency, are important in creating response. Avoidance has only been noted when sound intensity exceeds the hearing threshold of the fish at a given frequency by more than 30 dB (Mitson, 1995). Mann et al. (1998) found the hearing threshold of American shad to be 100 dB[1] within the frequency range of 200-800 Hz, 159 dB within the frequency range of 3.2-12.5 kHz, and 147 dB within the frequency range of 12.5-25 kHz. The hearing threshold for herring, for sounds between 20Hz and 1.2 Hz, was found to be at 75 dB (Mitson, 1995). Mitson (1995) also reported that for vessel noise, the distance where fish react was found to vary between 100 and 200 m for normal vessel noise (~125 to 150 dB between 1 to 1000 Hz), and up to 400 m for "noisy" vessels (up to 185 dB).

From the available literature, the noise levels produced by dredges (in particular clamshell bucket types) fall well short of the high frequency range (usually range between 20 - 300 Hz, although frequencies can be as high as 1 kHz depending on sediment type; Dickerson et

[1] The scale used to measure noise levels in air is different than the scale used to measure noise levels in water. All citations to dB above are in water and are in reference to 1 μPa at 1m from the sound source. To put water-based sound levels into perspective, subtract approximately 63 dB to get an equivalent air noise level.

al., 2001). According to the Dickerson et al. (2001) study, the most intense sounds produced during a dredging operation occur when the bucket strikes the sediment surface. Peak sound pressure levels were measured at 124 dB at a frequency of 163 Hz. Sounds ranged from 20 - 1000 Hz with maximum intensities near the source (within ~100m) around 110 dB. Additionally, the strength of sounds produced by dredging operations vary greatly depending on the sediment type. Soft sediments, such as those found in Mt. Hope Bay and the Taunton River, produce much "quieter" sounds that do not travel as far. Additionally, Wilson and Dill (2002) state that Atlantic and Pacific herring and other clupeoids, "respond to the sounds made by boats, tackle, sonar equipment, and most recently, acoustic deterrent devices for marine mammals" (citing Mohr 1971; Misund, et al., 1996; Kraus, et al., 1997). None of these articles mention the impact from dredges. Hence their relevance here is doubtful.

The dredge noises are at or just above hearing thresholds of anadromous fish, similar to normal vessel noise. Thus, the distance where fish would react would be within about 100 m of the dredge and any associated support vessels. Such a modest distance would not cause fish diversions to place them close to coast line hazards.

Dredging and Suspended Sediment

10 May 2006 e-mail:
After reanalyzing the Weaver's Cove Dredging Program Report and the Suspended Sediment Modeling Report, we contacted you for additional information on the physical aspects of the dredge material, e.g., grain size analysis and references related to suspended sediment impacts. You responded to these requests via phone, overnight mail, and email.

As described in Section 3.4 of the Modeling Report, the hydrodynamic model (WQMAP) was calibrated with field data collected from the Taunton River. The suspended sediment model (SSFATE) described in Chapter 4, however, was not calibrated with field data from that proposed activity.

Weaver's Cove's Response:
SSFATE estimates suspended sediment concentrations (TSS) generated from dredging activities based on bucket type, amount of scow overflow, the physical characteristics of the sediment being dredged (primarily grain size), and a number of other parameters. The SSFATE model was co-developed by ASA and USACE Vicksburg for the express purpose of providing an objective estimate of suspended sediment concentration levels for use in the evaluation of environmental windows (Johnson et al., 2000; Swanson et al., 2000). This model computes and reports sediment loadings above background levels and has been validated (Swanson et al., 2004) using monitoring data from actual dredging projects. It has been applied and tested for other projects as well, most recently in Oakland Harbor (San Francisco Bay) by USACE and ASA.

DOI/FWS/NPS apparently have doubts about the model because water column suspended sediment concentrations and resulting deposition thicknesses surrounding the dredge and predicted by the model have not been measured directly in the Taunton River and Mount Hope Bay with a direct comparison of site specific field results with model predictions. In short, they apparently conclude that the model results may not be accurate because no

dredging has actually been executed in the river and hence no site *specific* direct measurements are immediately available for the Taunton River and Mount Hope Bay.

In any event, the assertion in the May 10 e-mail is not correct. Site specific field data were collected to increase the accuracy of the SSFATE model prediction. In particular, site specific sediment grain size data were collected at discrete points within those areas of the Taunton River and Mount Hope Bay where dredging is proposed. SSFATE predicts the rate at which particles drop out of the water column based on the size and concentration of the sediment particles introduced into the water column as a result of dredging operations. The rate at which particles settle through water determines the suspended sediment in the water column and the thickness of any dredge induced depositional layer created by the dredging operation. As part of the Tier II and Tier III evaluations, the grain sizes of the specific sediments in the Taunton River were sampled, evaluated, and tested.

The science of settling rates associated with a set of particles falling through a column of water is reasonably well understood, documented, and can be predicted accurately with the proven models that are built into the SSFATE program. Particles of a given size and concentration falling through the waters of the Taunton River and Mount Hope Bay will settle at the same rate as particles in any other body of water. Thus the model has indeed been calibrated using site *specific* data – it simply has not been calibrated with a direct measure of sedimentation rate. The fact that the calibration technique does not use a direct measure taken in the Taunton River provides no logical basis for a conclusion that the model has not been calibrated and that the results are therefore suspect or in any way questionable.

In cases where the dredging has not yet taken place, as is the case here, a two-step analytical approach is typically used in this type of modeling studies when actual measurements of sediment loading rates (the rate at which sediment is introduced into the water column by dredging operations), and sediment settling rates (the rate at which the particles fall out of the water) are not available. First a literature survey of loss estimates (how much sediment is introduced into the river by the dredging operation) from measurements associated with other comparable dredging projects is performed. That was done and a case was made for the selection of an appropriate sediment loading rate. The second step is to perform a sensitivity analysis on the loss rate to show how the model results change as loss rate changes.

In the case of the Weaver's Cove dredging project, a comprehensive sensitivity analysis was performed using a range of loss rates (and other *model* parameters). A representative loss rate, based on site specific sediment characteristics, was chosen and then additional higher loss rates were used to check model performance. In fact, loss rates used in this study are six times higher than the representative measured rates. This analysis indicated that the model performs with a generally linear response: doubling the loss rate tends to double the sediment concentration and deposition.

In conclusion, the model results are based on site specific grain size data, well known and predictable settling rates of particles through water, and estimated sediment loading rates based on field measurements from other dredging projects. Sensitivity studies were then executed on the model to document the full range of potential impacts from dredging operations.

10 May 2006 e-mail:

The SSFATE model was used to simulate suspended sediment plumes based on various inputs to the model and predetermined subprograms in SSFATE. We agree with the statement in § 4.1.2 on page 54 of the Modeling Report that "One of the major factors that controls TSS concentration is how fast the sediment settles out from the water column." Figure 4.2 on page 55 shows the grain size distribution over the dredge reaches used in the ASA modeling report. However, when Figure 4.2 is compared to the grain size distribution for the individual sediment cores (in this discussion, cores include the 55 samples identified on page 18 of the Dredging Program Report), a number of discrepancies become apparent. For instance, the bar graphs of sediment grain size for each of the cores in Appendix D of the Dredging Program Report and the proprietary numerical grain size data provided in your April 27, 2006 email are represented in a different format and scale than the format and scale used in Table 4.3 of the ASA report. Just how these data are transformed into sediment class sizes using the grain size data in Appendix D is not explained, except for silt, which is arbitrarily split 50-50 between fine and coarse size classes.

Note: based on the discussion on page 54, it appears that ASA did not have the numerical grain size distribution data when formatting SSFATE input data. Figure 4.2 on page 55 shows the percent of coarse sand (actually fine sand >.130 mm in diameter) and fine sand (.075 - .130 mm) in the turning basin parent material to be 40 and 45% of the total, respectively. In fact, only 11 of the 27 cores for the turning basin have greater than 50% sand (retained on a 200 sieve), and meet the coarse sediment designation used in Appendix D, and only four of these have greater than 85% sand. The remaining 16 cores are predominately silts and clays. Accordingly, the average of these solid fractions in the turning basin as discussed on page 54 and represented in Figure 4.2 is open to question. This becomes an issue in the model results. For example, on page 59, Figure 4.5, the plume for native material is described as "a relatively small elongated area centered at the site because most of the material is coarse grain and quickly falls out of the water column." The data, except for the four cores mentioned above, do not support this assertion.

Weaver's Cove's Response:

First, ASA did have the full grain size distribution data set for use in formulating the SSFATE model runs.

Secondly, two separate modeling analyses were performed for the Turning Basin. One looked at the maintenance materials (softer, generally finer sediments). The other turning Basin analysis looked at the deeper native materials (more residual, somewhat coarse materials). In performing the analysis of Turning Basin native materials, core segments having higher fractions of coarse material were purposely selected such that the worst case sediment deposition rates could be studied (critical to the winter flounder egg deposition concern).

This analysis did indeed yield high deposition rates (in comparison to other cases). However, as shown on Figure 1, the area of dredge-related elevated suspended sediment levels (10 mg/l or higher) is very small in comparison to the analysis of the finer maintenance materials (Figure 2).

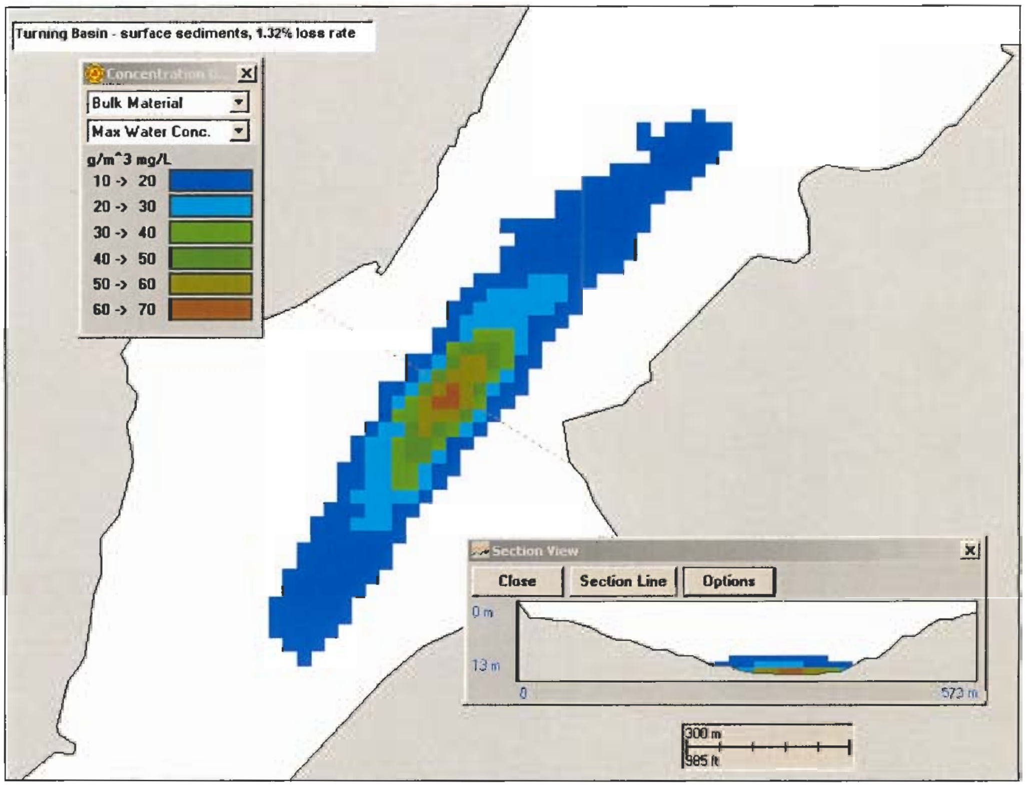

Figure 1. Scenario : Turning Basin – surface sediments, mean tidal stage with mean river flow, 1.32% loss rate.

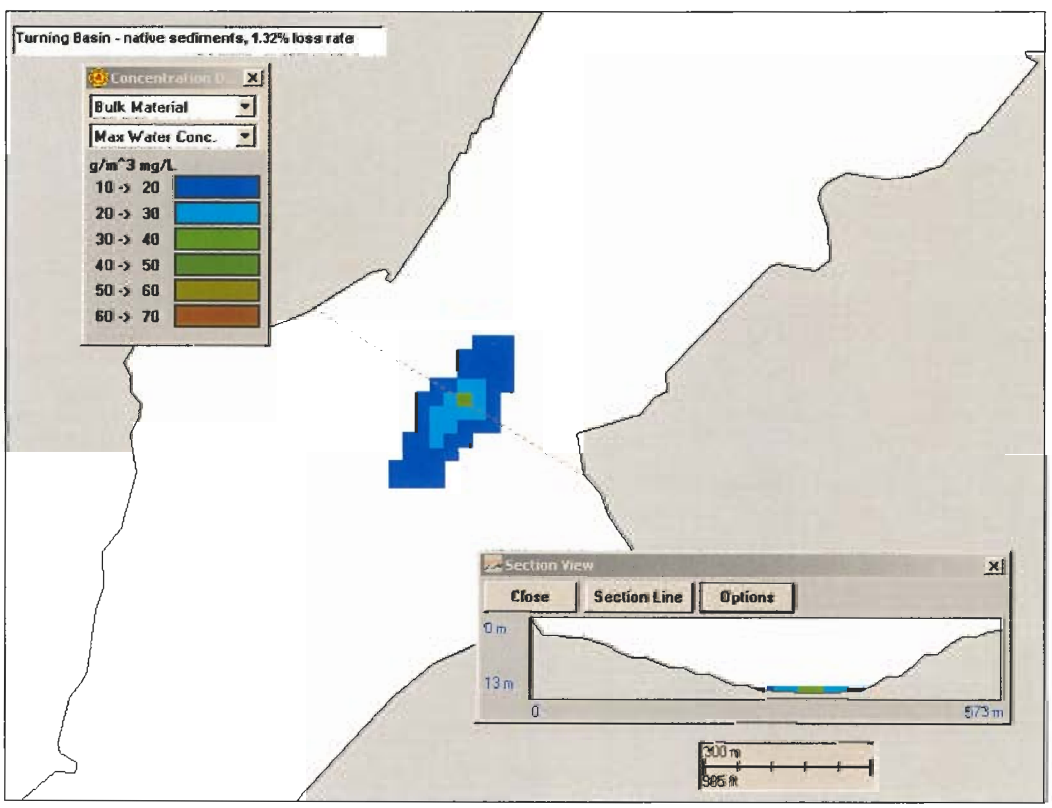

Figure 2. Scenario: Turning Basin – native sediments, mean tidal stage with mean river flow, 1.32% loss rate.

A more detailed discussion of the SSFATE modeling work follows.

The May 10 e-mail reflects an assumption that the grain size of the sediment has been mischaracterized somehow and this "error" has skewed the model results in a way that tends to make the model under-predict adverse impacts from dredging operations.

The important point to remember is that with regards to suspended sediment concentrations, an issue for migrating fish, dredging coarse grained sediments in the turning basin and dredging fine grained sediments in the turning basin have both been modeled. The results demonstrate that suspended sediment loadings fall well below effects thresholds for migrating fish in both cases. Hence the point raised in the May 10 e-mail with regards to sediment grain size simply cannot be an issue of concern with regards to outgoing fish migrations. The TSS levels associated with fine grained sediments are the controlling factor – and the models have shown these levels to be low and acceptable. When dredging coarse grained materials the TSS levels drop rapidly because the coarse grained material drops out relatively quickly.

The concern with coarse grained materials alluded to in the May 10 e-mail had very little to do with TSS levels and everything to do with the smothering of benthic organisms in the area surrounding the dredge. Since deposition rates associated with the Project are low, the only benthic organisms that are remotely a concern with regards to smothering are winter flounder eggs which are roughly 1 mm in diameter and rest on the bottom. Originally the "pass" criteria set by the resource agencies were 1.0 mm of cover in 21 days in waters less than 6 meters deep – and the ASA modeling showed no impact for either coarse or fine grained sediments at maximum dredge production. The resource agencies requested further analysis using 0.5 mm of cover in 40 days in waters less than 8 meters deep. There is no scientific support for the 4-day duration or 8-meter depth; however, this was modeled as an overly conservative scenario. With these criteria, the model showed several acres of potentially impacted areas in the area immediately surrounding the turning basin – but only when native (coarse grained) sediments are dredged.

Weaver's Cove believes that the grain size estimates and classifications were properly completed by the Project consultants. An important point made in the ASA Report that was overlooked in the May 10 e-mail is that the sediment size classes used in SSFATE model "...differ from other physical descriptions and classification methods used in other portions of the dredging and disposal effort but are required for this modeling effort" (ASA Report, section 4.1.2, pg 54).

ASA did in fact have an earlier spreadsheet with the identical grain size data supplied by others on the Project team responsible for overseeing the sediment analyses and development of the dredging program.

For the turning basin native material (the native material is the deeper material that has not been influenced by industrial activities), five cores listed in the proprietary grain size spreadsheet attached to the email of 27 April 2006 were used by ASA: TB-4 (6-10), TB-6 (13-15), TB-11 (8-17), TB-15 (5-11) and MA-19 (4-13). These cores were selected by the team from the 11 "coarse"-designated cores for the following reasons:

1) **There is not necessarily a direct correlation between coarse grained cores and native sediment. In particular, some coarse sediments could still be considered as depositional based on the characteristics of the river/bay where the sediment was collected. In particular, coarser sediments tend to preferentially deposit in center channel area where water flow rates tend to be highest while finer grained sediments tend to settle out in areas where water currents are lower. In actuality, the coarse designation was used in other reviews of the dredging operation by Project team members to help identify which samples would be least likely to have any potential pollution. For example, coarse grained sediments tend to be "cleaner" because the chemical constituents do not readily absorb onto sands – and sands tend to be the bulk of the coarse grained material.**

2) **In determining the physical location of the cores relative to the historical dredging that has been completed over the past 80 years within the turning basin, the location of the turning basin expansion, and proposed ship maneuvering areas were used to estimate which sediments were native (not previously anthropogenically altered) and non-native (deposited in the post industrial era).**

If one splits the "silt fraction" reported in the proprietary spreadsheet for the five selected cores evenly between SSFATE fine and coarse silt and then adds together the fractions reported as passing through a #60, #40 and #10 sieve and then averages these cores together, the results are as presented in Figure 4.2 of the ASA Report . These results are 4.8 % clay, 3.9% fine silt, 3.9% coarse silt, 45.0% fine sand and 42.5% coarse sand. If one averages the 11 "coarse" cores as the May 10 e-mail suggests, the results are largely unchanged with a high sand content of 77% (7.1% clay, 8.0% fine silt, 8.0% coarse silt, 43.7% fine sand and 33.2% coarse sand). Thus, the original conclusion that the SSFATE modeling results show that the plume for native material is "a relatively small elongated area centered at the site because most of the material is coarse grain and quickly falls out of the water column." stands. See Figure 1.

While there will be slight variations in sediment characteristics (including grain size) across the river and bay as the dredge moves from one area to the next, the potential impacts of these small variations in grain size on ASA's predictions of TSS levels and depositional thickness are relatively minor when one considers the fact that the model has been repeated with sediment loading rate particularly a full range from 0.22% to 1.32% loading rates (see a discussion of this topic below). Basically, the model has been run with all the estimated grain size fractions increased by a factor of six. While there may be some disagreement as to the exact split of grain sizes used in the model, the impact of these shifts has been fully covered by running the model with up to six times the predicted sediment loading rate.

10 May 2006 e-mail:
The loss rates of sediment during the dredging operation are discussed in § 4.1.1 Estimation of Source Strength and rely to a great extent on estimated sediment losses from a Boston Harbor study. Of particular concern is the assumption on page 52 that Boston Harbor sediments would be similar to Taunton River and Mt. Hope Bay sediments. Boston Harbor sediments contain a cohesive blue clay that forms clumps. These clays frequently exceed 40-50% of the maintenance sediment in the main ship channel (USACE 2003). The 55 Taunton River sediment cores generally contain only 10-15% clay. There is no evidence presented in the Dredging Program Report that these Taunton River materials are cohesive, that they form clumps, or that they are

resistant to erosion during dredging. Accordingly, we think it is reasonable to conclude that the loss rates and suspended sediment plumes may be underestimated in the Modeling Report. Connor et al. (2005), citing Van Ooestrum and Vroege (1994), state that 0-5% of the dredge material is resuspended during the dredging process. The Modeling Report, however, only used loss values at the low end of the scale-0.22 and 1.32%, respectively, for open and closed buckets-and did not model loss values at the upper end of the scale.

Weaver's Cove's Response:

The SSFATE model has been run at six times the field verified 0.22% loss rate measured for the Boston Harbor Dredging effort. The May 10 e-mail did not provide any evidence (nor did the February 7 Letter) to establish the apparent premise that the Taunton River sediment is so different from the Boston Harbor maintenance dredge sediment such that comparisons to the Boston Harbor study results are invalid (particularly when the Taunton River is modeled at a loss rate six times greater than the loss rate actually measured in Boston Harbor).

The SSFATE modeling for the Weaver's Cove Project was based on the relevant loss rate information that was published by Hayes and Wu in 2001 (pages 7 and 8) which ranged from 0.28 to 0.88% for open buckets and 0.10 to 0.22% for closed buckets. ASA chose values for analysis of 0.22 % for closed buckets and 0.66% for open buckets based on data from Boston Harbor for dredging of primarily maintenance material. Scow overflow rate was assumed to be equal to bucket loss rate (Hayes and Wu, 2001 page 8). It is important to note that the suspended sediment modeling results developed by ASA and presented to the agencies for over a year are based on a deliberately conservative 1.32 % (6 times the Boston value for closed bucket, no scow overflow). By focusing only on the Dec 2003 Modeling report and nothing else that has subsequently been submitted into the record, the 10 May 2006 e-mail simply ignores this key point.

Subsequent to ASA's completion of the SSFATE analysis for Weaver's Cove, a paper was presented at the 2004 Western Dredging Association (WEDA) conference in Orlando that described SSFATE model and data comparisons for two dredging operations, one in upper Chesapeake Bay, Maryland and the other in Panama City, Florida (Swanson, et al., 2004). An extensive field program was conducted at each site to track the strength and extent of the plumes generated by dredging activity. The SSFATE model was successfully calibrated to the observations using loss rates of 0.5% and settling rates higher than typically used based on particle diameter alone. This indicated that using higher loss rates (i.e. 2%) will result in much higher concentrations in the water column than were observed if one did not concurrently increase settling rates. The attached paper (Attachment A) summarizes these studies. It subsequently has been submitted for publication in the WEDA Journal in response to a request by one of its editors.

Most recently, Douglas Clarke of the ERDC USACE compared the SSFATE model to his plume mapping experiments conducted during the Providence River dredging. He presented his findings at a recent meeting (25 April 2005) to review research results conducted during the dredging operations. He found that the SSFATE model was consistently conservative. His other conclusions indicated that a higher loss rate can be used, but must be balanced by significantly higher settling coefficients to account for suspected flocculation processes that remove the sediment from the water column quickly.

Alternatively, lower loss and settling rates can be used to achieve the same result that matches the data.

The Weaver's Cove analysis used lower rates for both loss and settling to correspond to the data taken in Boston. The use of a 2% loss rate is not an appropriate value to be used in the assessment of actual dredging operations unless a higher settling rate is also used to account for flocculation.

The van Oostrum and Vroege (1994) paper referenced in the May 10 e-mail was reviewed and found to summarize a series of 22 monitoring "campaigns" conducted in the Netherlands for a variety of dredging types. Their notation of grab dredger is equivalent to the bucket dredging technology proposed for this project. They report on 7 grab dredger monitoring studies with estimated loss rates from 0.4 to 5.1% with a mean of 2.0% and a standard deviation of 1.6%. Six of the 7 studies estimated rates less than 2.5% with one at 5.1%. Their summary section (page 219) starts with the following:

> **Based on field measurements it is concluded that the resuspension of sediments (sand/silt mixtures), depending on the characteristics of the dredging project, fall within the 0 – 5% range of the quantity of dredged sediments. Within this range the way dredging is carried out (yes / no overflow, careful excavation versus production dredging) strongly influences the quantity of sediments resuspended.**

Unfortunately no information was provided in the paper on the type of bucket (open or closed) used nor whether there was scow overflow which makes any meaningful extrapolation to this project impossible. In marked contrast, the Hayes and Wu (2001) data used by ASA includes relevant information on specific dredging locations, bucket type (open, closed) and scow overflow. More detailed plume tracking data was presented by Reine, et al. 2003, as referenced by Swanson, et al. 2004, and was used in SSFATE model validation studies. A copy of the Swanson, et al. 2004 study is provided as Attachment A.

In addition, it is interesting to note that van Oostrum and Vroege (1994) (page 213) made the following observation on the resettling of the resuspended sediments:

> **The results of the turbidity campaigns show that the vast majority of the sediments (sand/silt) resettled within one hour after dredging. Only a very small fraction (the very fines) took longer to resettle.**

10 May 2006 e-mail:
The suspended sediment modeling on pages 57-63 shows suspended sediment plumes with a maximum concentration of 40 mg/l. These results are noteworthy when compared to the measured results from other mechanical dredging projects. Wilber and Clark (2001) cite a study (LaSalle 1990) of a clamshell dredge where the maximum sediment plume concentration of 1,100 mg/l extends as far as 1,000 m along the bottom. Suspended sediment concentration from an open bucket dredge in Black Rock Harbor was reported to be 1,100 mg/l by McLellan et al. (1989) as cited in Connor et al. (2005).

Weaver's Cove's Response:
Table 2 (page 7) in LaSalle (1990) presents bottom concentrations from bucket dredging to be LESS THAN or equal to 1100 mg/L and plume lengths to be LESS THAN or equal to

1000 m. Nowhere in the paper is there any discussion that a maximum sediment plume concentration of 1100 mg/L extends as far as 1000 m. In fact, the section on bucket dredges (page 4) states:

> **...a typical bucket dredge operation can be described a producing a downstream plume which extends up to 300 m at the surface and 500 m near the bottom. Maximum suspended sediment concentrations in the surface plume are generally less than 500 mg/L in the immediate vicinity (100 m) of the operation, decreasingly rapidly with distance due to settling and dilution.**

LaSalle (1990) refer to McLellan et al. (1989) as one of the sources for Table 2 consistent with the reference by Connor et al., (2005). In fact McLellan (1989) indicate (page 60) the sediment was "sandy organic clay with greater than 90% fines. The liquid limit was 170, plastic limit was 65, and the wet weight was 72 lb/cu ft with 25-percent solids content." One of the authors of that report (Hayes, personal communication) relates that the sediment was "as resuspendable as any dredged sediment I have seen". A 10 cu yd open bucket was used (unpaginated Table 14). The report indicates a maximum contoured concentration level of 1100 mg/L (page 63 and Tables 12, 14 and 15) but the data presentation in Appendix B indicates a maximum concentration of 1400 mg/L at the bottom (page B4). This measurement was taken at a distance downstream of the dredge of approximately 60 m (*not* 1000 m) (page B4). In fact, the report notes that the peak measurements did not occur at the dredge but some distance downstream (page 64) due to the tidal currents. Under similar conditions SSFATE also shows the maximum concentration occurring some distance away from the dredge due to the advection of the peak concentration that was generated during slack water, away from the dredge location.

In summary, the statement of a suspended sediment concentration of 1100 mg/L as far as 1000 m from the source is not in the original report and appears to based on a misreading of the actual measurements reported. Weaver's Cove does not believe it is either appropriate to rely on such inexact data reported in LaSalle nor is it the best evidence available, particularly when there is available actual monitoring data from projects in Narragansett Bay and elsewhere. It should be also noted that the maximum dredge plume TSS concentration reported from the Providence River and Harbor dredging project compliance monitoring was 78 mg/L (from monitoring reports downloaded from RIDEM website).

<u>10 May 2006 e-mail:</u>
The duration of these plumes is dependent on many factors. One factor mentioned on page 57 of the Modeling Report and also by Wilber and Clarke (2001) is "fluffing effects", in which settling of particles is inhibited as concentrations of suspended sediments in the water column increase. Fluff zones can persist for days or weeks. The ASA modeling report did not include fluff effects because the "water content is unknown" (page 57).

***<u>Weaver's Cove's Response</u>*:**
We were unable to locate the Wakeman, et al., (1975) report referenced in the May 10 e-mail. That report actually is referenced by Wilber and Clarke (2001), so Weaver's Cove contacted Don Hayes, Professor at the University of Utah, expert in the dredge material field about this issue. His observations follow:

This seems like a clear case of confusion to me. Increasing TSS concentrations increases settling rates until such a high concentration that inhibited (zone) settling occurs. Depending upon the sediment and environment, that would normally occur at levels of at least 100,000 mg/L [10% solids], i.e. it doesn't happen in the water column. At lower concentrations, increased TSS increases flocculation and settling. Actually, turbulence helps cause particle contact and increases flocculation as well. It is important to remember that non-native sediments being dredged are there because they had a tendency to settle in that environment once; they will have a propensity to do so again. As for the "fluff layer", that is organic matter that separates from the suspension because these particles have a very, very low settling velocity. They will stay in the nepheloid suspension [the particle rich layer that may exist just above the bottom] at a near equilibrium condition for days, more so in freshwater conditions (Lake Okeechobee is an example) than estuaries. If this layer exists, it certainly can move about with even minor currents. But, the mass of solids in this layer is generally low (typically 20-30 mg/L), and it hangs right near the bottom, somewhat as an extension of the bed sediments. (E-mail from D. Hayes to C. Swanson, 30 May 2006)

<u>10 May 2006</u> email:
In view of the above, we believe the model simulations of the suspended sediment plumes should be regarded as "draft", in need of considerable ground truthing (calibration) using field data collected from the Taunton River/Mt. Hope Bay environs. In addition to suspended sediment plumes from dredging, the suspended sediment plumes from ship traffic to and from the terminal need to be measured and simulated over a range of conditions so that a more realistic assessment of near- and far-term impacts associated with the construction and operation of the Project can be considered. The spatial, temporal, and other characteristics of the various stratification phenomena that occur in the Taunton River/Mt. Hope Bay system relating to dissolved oxygen, temperature, salinity, or other factors need to be identified and delineated. The extent to which these factors affect suspended sediment distribution from dredging and/or ship traffic needs to be identified and factored into the various physical and biological analyses. Due in large measure to these factors, we did not spend time reviewing the SSDOSE model results since it is dependent on SSFATE results.

<u>Weaver's Cove's Response:</u>
At this late stage of the permitting process, and after the plain declaration of position in the February 7 Letter, the fact that the only support for the DOI position is the assertion above as to "concerns" is remarkable. "Concerns" are not evidence in support of the February 7 Letter. Concerns are at best unformulated, unsupported opinions. Even more troublesome is that in the May 10 e-mail there is the statement that the agency has concerns with the SSDOSE model but is not willing to highlight those concerns. Such a position or non-position does not move the scientific debate forward in an organized or meaningful fashion. To vaguely refer to various phenomenon and "other factors" and then not articulate clearly why they are a concern reveals that this is an unsupportable position.

Measurements of characteristics indicating stratification, such as dissolved oxygen, temperature, and salinity, are not among the data inputs to the modeling. The field program conducted for the Project showed that any temperature or salinity stratification that did occur at the terminal site was found to break down during the biweekly spring

tides (ASA Report, pg 11). This breakdown of stratification is seen in other areas in the greater Narragansett Bay system.

The measurements of dissolved oxygen at the terminal site indicated that during the period DO averaged 10.7 mg/L at the surface and 11.7 mg/L at the bottom, relatively high values. The surface and bottom waters mix during spring tides (ASA Report, pg 15).

As to LNG ship traffic, there will be no LNG ship transits to the terminal during the period of dredging. Thus, the perceived concerns regarding suspended sediment plumes from ship traffic to and from the terminal are not relevant to the setting of time-of-year windows for the dredging.

Alternative Dredging Plans

10 May 2006 e-mail:
During our April 18, 2006 meeting, we discussed various dredging scenarios that would enable Weaver's Cove Energy to accomplish the dredging program within a three-year construction time frame and within the 2½-month dredging window provided by the January 15-October 31 time-of-year restriction to protect fish stocks. While this dredging window creates constraints, no one from Weaver's Cove Energy indicated that the Project would become impracticable if additional dredging equipment were used.

Weaver's Cove's Response:
DOI/FWS/NPS representatives asked a number of "what if" questions at the April 18 meeting. Could Weaver's Cove use more dredges? Could Weaver's Cove use bigger dredges? Could Weaver's Cove use a large fleet of barges and tugs to "work around" the bad weather conditions experienced in November, December and January, etc. all aimed at cramming the dredge program into three 2 ½ month seasons. Weaver's Cove representatives explained that the Project wanted to have a workable and realistic dredge schedule, a schedule which reflected the real world constraints of weather, equipment availability, operating logistics, staffing and the possibility of equipment breakdowns. Weaver's Cove representatives supported these points with a number of facts: (1) the planned 26 CY dredge is the largest currently available, and the Project hopes to secure one, possibly two from the very limited fleet in the US (five total); (2) if operating in a very compressed season, we cannot assume that all planned dredges will be on site and ready to begin on December 1 (three years in a row); (3) weather downtime in December/January could approach 50% of the available time, and Weaver's Cove will not press the contractor to operate in unsafe conditions in order to make an unrealistic schedule; (4) there are limits on the rate at which material can be discharged at RISDS (~6 loads per day); and (5) the compressed dredge season includes several holidays, etc.

Such a compressed program would add greatly to the cost of an already expensive undertaking and would add major schedule risks to the Project. Finally, it should not be forgotten that the dredging was being undertaken entirely at the Project's expense; a large part of the program is maintenance dredging that would normally be undertaken by the USACE at taxpayer expense.

10 May 2006 e-mail:

Weaver's Cove Energy's October 15, 2004 response to FERC also discusses some of the constraints and clearly states on page 7 that "Each of the three dredging window scenarios can be managed to meet the overall Project schedule consistent with the design proposed in Weaver's Cove application if 100% offshore disposal proves feasible." We understand that about 97% of the material has been approved for open water disposal and assume that the remaining 3% can be accommodated on site.

Weaver's Cove's Response:

The single sentence that is quoted is excerpted and taken out of context from an 8-page discussion that Weaver's Cove provided to the FERC Staff on November 4, 2004. In that response, Weaver's Cove addressed in detail a data request dated October 15, 2004 that requested Weaver's Cove, among other things, to "assess the effect on the proposed project design, schedule, and costs if dredging is not allowed or is severely restricted during" certain identified restriction periods. As can be seen from a reading of the entire Weaver's Cove response, a copy of which is attached as Attachment B, the single sentence that is quoted has been taken out of context.

Weaver's Cove never suggested that offshore disposal was a panacea for any time-of-year dredging restrictions, whether reasonable or severe. As Weaver's Cove explained, while dredging windows could be "managed" in the event that offshore disposal is used, this does not mean that dredging restrictions are therefore without environmental or cost consequences. Indeed, as Weaver's Cove stated in the very next sentence immediately following the sentence that is quoted, with limited dredging windows available "the potential environmental impacts will involve trade-offs between production rates and suspension of sediments in the water column". Weaver's Cove also made clear its position that "[u]sing sound scientific principles and analysis, Weaver's Cove believes that its numerous studies have demonstrated dredging windows and time of year restrictions that force shutdown of the dredge fleet *do not provide additional protection for the environment* above that in the filed program." (emphasis added) Thus, any implication in the e-mail that offshore disposal provides some independent basis or justification for the imposition of dredging restrictions through the end of October is both misleading and incorrect.

10 May 2006 e-mail:

We assume also that Weaver's Cove Energy has gained some increased flexibility now that two disposal sites are available for 97% of the material.

Weaver's Cove's Response:

The second disposal site is the Massachusetts Bay Disposal Site ("MBDS"). Its use was contemplated in the Tier III sampling as a fallback to RISDS. Weaver's Cove's clearly stated intention is to use RISDS; this newly designated site is intended to serve dredging projects in Rhode Island and southeastern Massachusetts. RISDS is located in Federal waters off the mouth of Narragansett Bay, approximately 37 nautical miles from the turning basin. The site has more than sufficient capacity to accept the full dredge volume being contemplated.

As discussed in the FEIS and in submittals that Weaver's Cove has made to the FERC, the USACE and other agencies, MBDS is located off Boston Harbor and is nearly 140 nautical miles from the Turning Basin via Buzzards Bay and the Cape Cod Canal. It is nearly 340

nautical miles distant via the primary shipping lanes to the south and east of Cape Cod. Assuming that dredging was to be limited to November, December and the first half of January, as recommended in the February 7 Letter, winter storms would reduce the number of work days and would certainly complicate and increase the risks of using MBDS.

10 May 2006 email:
If you have any questions regarding the above, feel free to give me a call at (603) 223-2541.

Vern

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ATTACHMENTS:

A. Swanson, et al., 2004 "Simulations of Dredging and Dredged Material Disposal Operations in Chesapeake Bay, Maryland and Saint Andrew Bay, Florida"

B. Weaver's Cove Energy, LLC Responses to the Federal Regulatory Commission Staff's October 15, 2004 Environmental Data Requests

Attachment 1-A

Swanson, et al., 2004
Simulations of Dredging and Dredged Material Disposal Operations in Chesapeake Bay, Maryland and Saint Andrew Bay, Florida

SIMULATIONS OF DREDGING AND DREDGED MATERIAL DISPOSAL OPERATIONS IN CHESAPEAKE BAY, MARYLAND AND SAINT ANDREW BAY, FLORIDA

J. C. Swanson[1], T. Isaji[2], D. Clarke[3] and C. Dickerson[4]

ABSTRACT

Modeling analyses were performed to test simulations of suspended sediment transport and deposition resulting from a dredging operation in the Upper Chesapeake Bay, Maryland. Similar analyses were conducted for a hydraulic pipeline open-water discharge at Panama City, Florida. The Maryland project consisted of modeling the sediment plume created by a bucket dredge excavating maintenance sediment in the Brewerton Cutoff navigation channel. The Florida project consisted of modeling the sediment plume from a submerged discharge associated with a hydraulic cutterhead dredging operation. The goal of both studies was to calibrate the model applications using appropriate source strengths and settling rates as determined by extensive field surveys of the short-term fate and transport of the resultant sediment plumes.

SSFATE (Suspended Sediment FATE) was used to estimate water column suspended sediment concentrations and bottom deposition patterns resulting from both dredging operations. The HYDROMAP hydrodynamic model was used to predict circulation in the project areas. Knowledge of the dredging and disposal processes was used to establish required input parameters, including sediment release rates and vertical distribution of initial material release. Representative particle classes were dispersed in the water column and tracked until deposition.

Field data, consisting of acoustic Doppler current profiler surveys yielding the velocity structure and suspended sediment distributions, fixed station deployments of optical turbidity sensors, and discrete water samples for gravimetric analyses, were compared to SSFATE output. In both scenarios the default input settings of SSFATE produced dispersion patterns on much broader spatial scales than observed in field surveys. Sediment release rates of 0.5% were found to best match both the bucket dredging and pipeline discharge observations. Likewise, settling rates of different sediment fractions were found to be greater than empirically derived rates for fine particles. A viable explanation for these observations is that clay and silt-sized particles form flocculants that settle at a rate equivalent to coarser sand grains. Flocculation behavior of fine sediments may significantly affect plume dynamics and should be a critical consideration for modeling applications. Results underscore the value of field data for model calibration.

Keywords: Dredging, disposal, modeling, suspended sediment, transport

INTRODUCTION

One of the major responsibilities of the U. S. Army Corps of Engineers (USACE) is to ensure that designated portions of the nation's waters are navigable. This typically requires that dredging be periodically performed to maintain shipping channel depths. An inherent concern in this process is that of potential impacts on environmental resources as a consequence of dredging and dredged material disposal operations. Potential impacts may occur from increased suspended sediment concentration in the water column as well as deposition of sediment to the bottom. To address these concerns the USACE and Applied Science Associates, Inc. (ASA) have been developing a computer model known as SSFATE that simulates the transport and fate of suspended sediments that have been injected into the water column from dredging operations. This model has been tested against a limited number of cases and results are promising. A full validation has not yet been completed. For this reason the USACE has undertaken a set of field experiments designed to map suspended sediment plumes in the water column for comparison with SSFATE simulations. A hydrodynamic model, HYDROMAP, was used to generate water currents in space and time. This paper

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provides results of SSFATE model predictions and field data for two field studies, in Chesapeake Bay, MD and Saint Andrew Bay, FL.

HYDROMAP AND SSFATE MODEL DESCRIPTIONS

ASA has developed and applied evolving versions of sophisticated model systems for use in studies of estuarine and coastal waters for more than two decades. These models are either general, i.e. hydrodynamic models to predict circulation, or process specific, i.e., oil spill or suspended sediment fate and transport. A general circulation model is typically required to provide time and space-varying currents for use in a process specific transport model. HYDROMAP is an example of the former and SSFATE is an example of the latter.

HYDROMAP Model Description

HYDROMAP is an ASA product that provides a quickly applied, but highly variable resolution hydrodynamic model that can handle complex features in the coastal and estuarine environment. The advantage to the system is that large areas of widely differing spatial scales can be addressed within one model application with a relatively small setup effort. The underlying model implementation is a rectangular, a finite difference model. HYDROMAP uses a stepwise-continuous-variable-rectangular grid (SCVR) approach, a modification of the standard rectangular gridding approach, which allows the user to easily set up a rectangular grid structure with up to six levels of grid resolutions. The term "stepwise-continuous" implies that the boundaries between successively larger and smaller grid sizes are managed in a consistent integer stepped manner. "Variable" denotes that the grid sizes are variable over the grid domain. Gridding tools within the HYDROMAP system allow the user to create a rectangular grid system and select locales within that grid structure for finer grid resolutions. Each grid cell has four orthogonal sides. All grid cells are the same size and shape. The SCVR gridding strategy gives the grid developer tools to easily generate multiple grid resolutions in relatively complex geometries. The user need not pay strict attention to the placement of particular grid cell boundaries, but can define areas of successively higher grid resolution by drawing "boxes" around areas requiring additional resolution. The underlying hydrodynamic model then solves the equations of motion for the water movement in a single simulation. HYDROMAP has been successfully applied to a number of areas (Isaji et al., 2001, Zigic et al., 2003).

The underlying hydrodynamic model is based on Owen (1980) and further developed by Isaji and Spaulding (1984, 1987). It uses continuous vertical profiles at each grid cell to represent the velocity. The basis of the model is formed by the three-dimensional conservation equations in spherical coordinates for water mass and momentum with the Boussinesq and hydrostatic assumptions. The solution methodology for the SCVR gridding entails the definition of an extra equation at each interface where cells of differing grid sizes meet. This extra equation is solved implicitly.

A non-obvious advantage to the gridding scheme is the consistency of the time integration for varying depth. For a fixed size grid, an optimal computational time step depends on the depth; a shorter time step is required for deeper water. In this scheme, the deepest water depth determines the length of the model time step. For all of the shallow grid cells, not requiring such a small time step, computational resources are wasted. The SCVR scheme, with its implicit solution methodology, allows this time step restriction to be relaxed.

The primary input data needed for model application are: coastline definition to define the land-water boundary, bathymetry soundings to define the depth of water cells in the grid, tidal elevation constituent harmonic definitions (elevation and phase), and wind stress forcing.

SSFATE Model Description

SSFATE, developed jointly by ASA and the US Army Engineer Research and Development Center (ERDC), simulates sediment re-suspension and deposition from dredging operations. It has been documented in a series of USACE Dredging Operations and Environmental Research (DOER) Program technical notes (Johnson et al. 2000; Swanson et al. 2000), at the World Dredging Conference (Anderson et al. 2001), and in a number of ASA technical reports.

SSFATE (Suspended Sediment FATE) computes suspended sediment distributions and deposition patterns resulting from dredging operations. Ambient currents can either be imported from a number of classes of 2-D and 3-D numerical hydrodynamic models, e.g., HYDROMAP. The model predicts the transport, dispersion, and settling of suspended sediment released to the water column during dredging operations using a random walk procedure. SSFATE simulates suspended sediment source strength and vertical distribution for mechanical (e.g., clamshell) or hydraulic (e.g., cutterhead, hopper) dredges, dredge disposal operations, or other sediment disturbance activities such a jetting or plowing for cable and pipeline burial. Multiple sediment types or fractions can be simulated simultaneously. Model output consists of concentration contours in both horizontal and vertical planes, time series plots of suspended sediment concentrations, and thickness contours of sediment deposited on the sea floor. Sediment particle movement and concentration evolution can be animated over Geographic Information System (GIS) layers depicting sensitive environmental resources and areas.

Depending on the resolution of the numerical grid employed, SSFATE can make predictions close to the dredging operation; however, the processes modeled are not near-field sediment re-suspension dynamics, but rather are far-field (>25 m [80 ft]), in which the mean transport and turbulence associated with ambient currents dominate. A particle-based model predicts the transport and dispersion of the suspended material. Particle advection is based on the simple relationship that a particle moves linearly with a local velocity, obtained from the hydrodynamic model, for a specified model time step. Particle diffusion is assumed to follow a simple random walk process.

The particle model allows the user to predict the transport and fate of five classes of settling particles, e.g., coarse and fine sands, coarse and fine silts, and clays. The fate of multi-component mixtures of suspended sediments is predicted by linear superposition. The particle-based approach is extremely robust and independent of the grid system. Thus, the method is not subject to artificial diffusion near sharp concentration gradients and is easily interfaced with all types of sediment sources.

In addition to transport and dispersion, sediment particles also settle at some specified rates through the water column to the bottom. Settling of mixtures of particles, some of which may be cohesive in nature, is a complex process with the different size classes interacting, i.e., the settling of one particle type is not independent of the other types. In addition, the clay-sized particles, typically cohesive, undergo enhanced settling due to flocculation. These processes have been implemented in SSFATE and are based on previous USACE studies (Teeter, 1998).

At the end of each time step the concentration of each sediment class as well as the total concentration is computed on a dynamic numerical grid. The size of all grid cells is the same, with the total number of cells increasing as the suspended sediment moves away from the dredging source to encompass the plume. The settling velocity of each particle size class is computed along with a deposition probability based on shear stress. Finally the deposition of sediment from each size class from each bottom cell during the current time step is computed and the calculation cycle begins anew. Deposition is calculated as the mass of sediment particles that accumulate over a unit area.

APPLICATION TO DREDGING OPERATIONS IN CHESAPEAKE BAY, MARYLAND

Concerns for protection of fishery resources and their habitats in Chesapeake Bay are frequently related to suspended sediments and their subsequent deposition. Potential impacts include: smothering of demersal eggs as a result of sedimentation; clogging or abrasion of gill tissues caused by suspended particles; blockage of migratory pathways of various anadromous fishes; turbidity effects on submerged aquatic plants (Parr et al. 1998); and negative effects on growth and survival rates of shellfish (Pratt and Campbell 1956; Kirby 1994).

Plume characterization studies were conducted at an open-water site located in the Brewerton Channel Eastern Extension, an entrance channel to the Port of Baltimore. The study area can be located on National Oceanic and Atmospheric Administration nautical chart 12278 at approximately 39°08.69' N and 76°19.64' W.

Chesapeake Bay Field Study

Because plumes can change dynamically over large spatial scales and short time scales, characterizing plumes presents severe challenges. Acoustic technologies offer advantages in capturing data at appropriate spatial and temporal scales to allow accurate interpretation of plume dynamics. In the present study an RD Instruments 600-kHz Mariner Workhorse® Series acoustic Doppler current profile (ADCP) was employed to characterize both ambient conditions and dredging-induced plumes resulting from bucket dredging operations. The ADCP determines current velocities and direction vectors based on acoustic backscatter from particles moving through the water column. ADCP backscatter data are also used to derive estimates of suspended sediment concentrations. ADCP raw backscatter data were analyzed using Sediview Software provided by Dredging Research LTD. The Sediview Method (Land and Bray 2000) derives estimates of suspended solids concentration for each ADCP acoustic backscatter data bin throughout the water column.

Ambient and during-dredging conditions were surveyed during both ebb and flood tides in December 2002. Surveys typically consisted of 12 to 16 parallel transects spaced at distances of 25 to 200 m apart with increasing distance from the dredge. Two dredges were operating approximately 2.5 km apart during most surveys. Transects were established at distances up to 1,500 m from the sources, where detection of plume acoustic signatures against background conditions was lost.

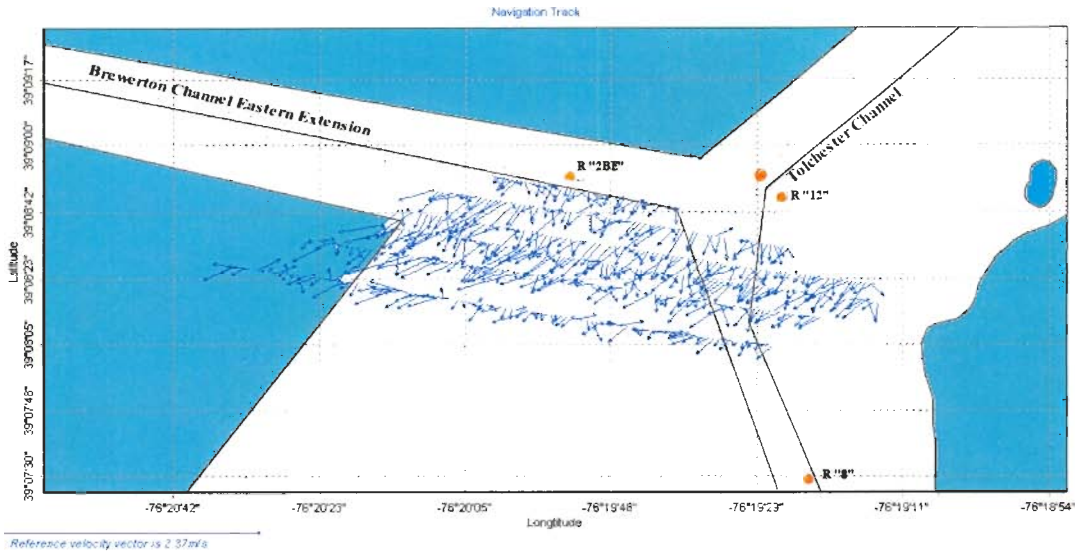

Figure 1. An example of ebb tide vertically averaged velocity vectors from an ADCP record.

Suspended Sediment Calibration: In order to convert acoustic backscatter to total suspended sediment concentration (TSS in mg/l), the ADCP data were based on water samples collected at specific locations within the ADCP beam at stations exhibiting a broad concentration range as analyzed gravimetrically. Water sample TSS concentrations were then matched to an exact acoustic ping number in the corresponding ADCP data file. Calibration results produced a close correspondence between observed and acoustically estimated concentrations for the Brewerton Channel data set for concentrations up to 300 to 400 mg/l. Loss of correspondence was limited to samples collected very close to the source. Therefore, a relatively high degree of confidence can be placed in far-field concentrations.

Suspended Sediment Plume Characterization

Although both flood and ebb tide plumes were monitored, only ebb tide plume characteristics are discussed herein. Additional information can be found in Reine et al. (2003a). An ebb tide suspended sediment plume was tracked while two bucket dredges (Weeks Marine 550 and 551) were operating in the Brewerton Channel using 25 cubic yard open buckets. The plume associated with Weeks Marine Dredge 551 was designated the primary plume. Weeks Marine Dredge 550 generated a secondary plume. General direction of plume movement was southwest, away from both the Brewerton and Tolchester Channels as depicted in Figure 2, a plan-view depiction of both plume acoustic signatures. Figure 3 shows a vertical cross-section of the plume signatures at 175 m down-current from the primary dredge.

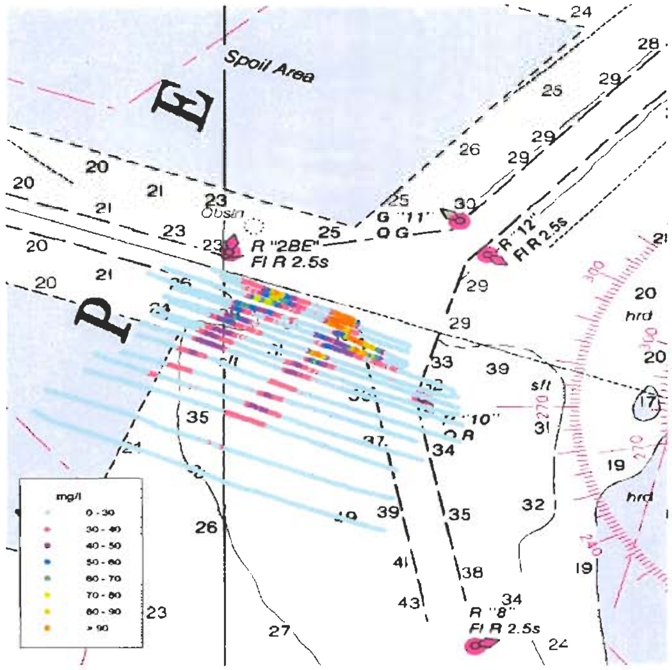

Figure 2. Depth-averaged suspended sediment concentrations (mg/l) of two plumes surveyed during an ebbing tide.

The vertical profile shows a second plume (right side of profile) at 300 m as having a well-defined core, with TSS concentrations greater than 225 mg/l. The secondary plume had settled in the water column as compared to the primary plume (left side of profile). No evidence of a surface plume was present at that distance. At 175 m down-current from the dredge, concentrations greater than 225 mg/l were found only at depths greater than 6 m. The plume dispersed toward the southern shoal of the Brewerton Channel and had a cross-sectional width of 300 m. Results clearly demonstrate the site-specific nature of suspended sediment plume behavior. Generally low ambient TSS concentrations allowed unambiguous plume signatures to be detected.

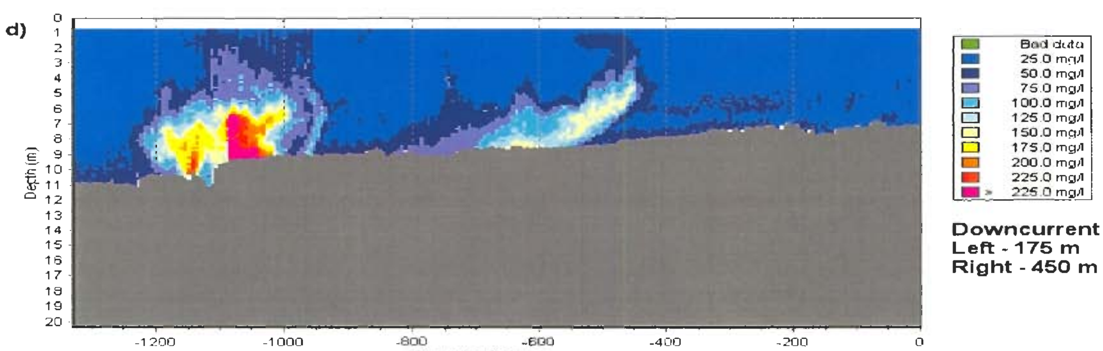

Figure 3. Example transect depicting changes in suspended sediment plumes during an ebb tide survey at the Brewerton Channel study site. Distances from the source for both plumes are given in the legend located at the right of the graph.

Deployments of optical turbidity sensors supplemented the acoustics surveys. At fixed points within the plume, spikes in turbidity values reached approximately 220 NTU at 70 m from the source. These turbidities are roughly equivalent to TSS values of 300 mg/l. The detected pattern of moderate turbidities above ambient with intermittent spikes of one to fifteen minute duration is indicative of a heterogeneous rather than homogeneous plume

In the open waters of the Upper Chesapeake Bay, bucket dredging operations created plumes that could be detected up to 1,500 m from the source. Intense plume signatures approximately 200 m wide from surface to bottom were created by the bucket's cycling through the water column, but TSS concentrations above 100 mg/l were largely restricted to within 750 m from the source, and concentrations above 50 mg/l to within 1,000 m from the source. Plumes tended to broaden as they were carried downstream, with observed features as wide as 400 m. Although the dredged sediments were predominantly silt/clay fractions, surface components of the plumes dissipated within relatively short distances from the source. Mid- and lower water column components of the plumes displayed much greater complexity, interacting with prevailing water currents and bottom bathymetries. Here water velocities were relatively strong, ranging as high as 1.3 m/sec during flood tide. Re-suspended sediments remained primarily within the deeper channel basin waters.

HYDROMAP Model Application

The grid for the HYDROMAP model is shown in Figure 4. The grid resolution increases from 2.8 km at mouth of bay to 0.7 km in the upper bay in the vicinity of the Tolchester dredging location. Bathymetric variation is shown in color in 2 m increments.

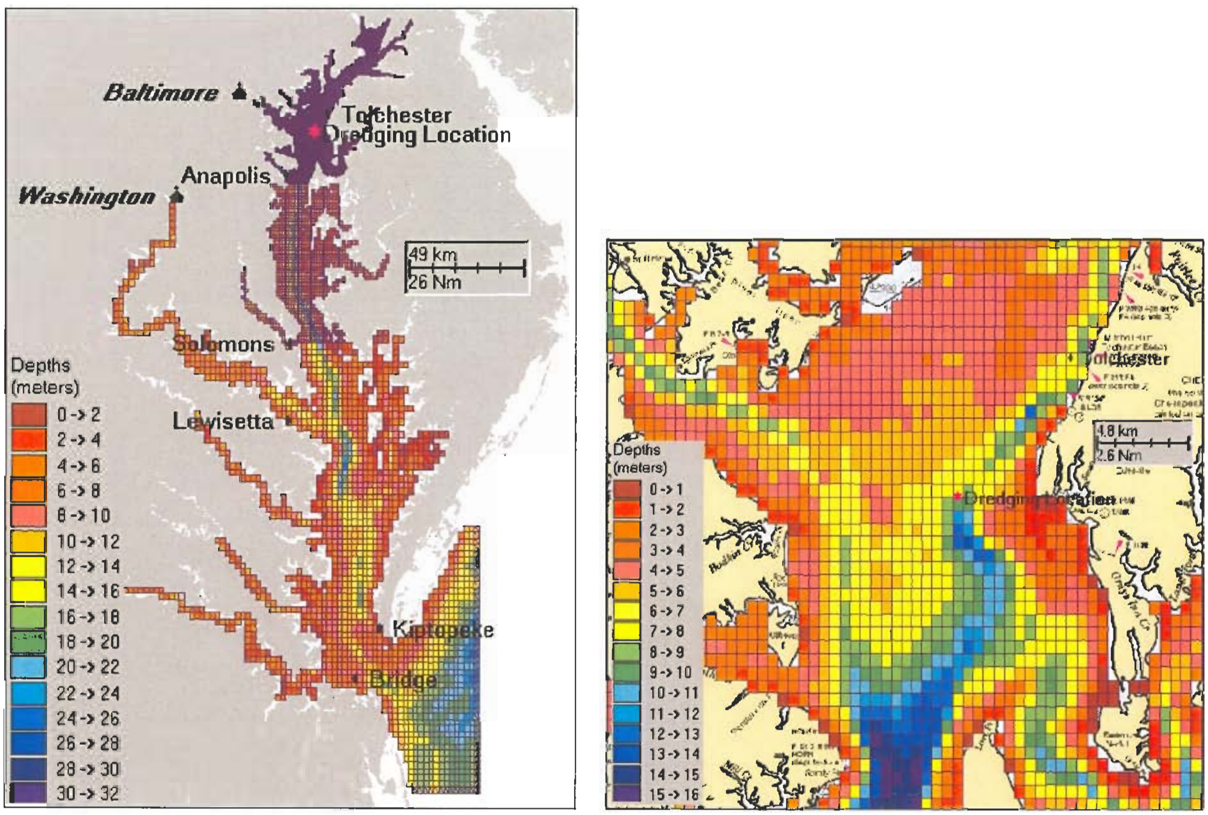

Figure 4. Hydrodynamic model grid for Chesapeake Bay. The grid resolution increases from 2.8 km at mouth of bay (left frame) to 0.7 km in the upper bay (right frame).

The HYDROMAP simulation was performed for the period from 1 Dec 2002 to11 Dec 2002 (10 days). The simulation was forced with; 1) water level elevations observed at the Chesapeake Bay entrance bridge (NOAA, National Ocean Service, CO-OPS, Products and Services, N/OPS3), 2) wind records from the City of Baltimore (Chesapeake Bay Observing System), and 3) discharge flows from the Susquehanna River (600 m^3/sec, USGS, Surface Water for USA: Daily Stream flow).

The dominant factor that defines circulation in the bay is the water elevation at the bay mouth. Surface wind stress and the Susquehanna River flows were not significant driving forces for the study region during this period. Figure 5 shows a comparison of predicted elevations and observed water levels (NOAA CO-OPS) at Tolchester Beach, Maryland, and Figure 6 shows examples of flood and ebb flows, which compared well with ADCP observations, as exemplified in Figures 1.

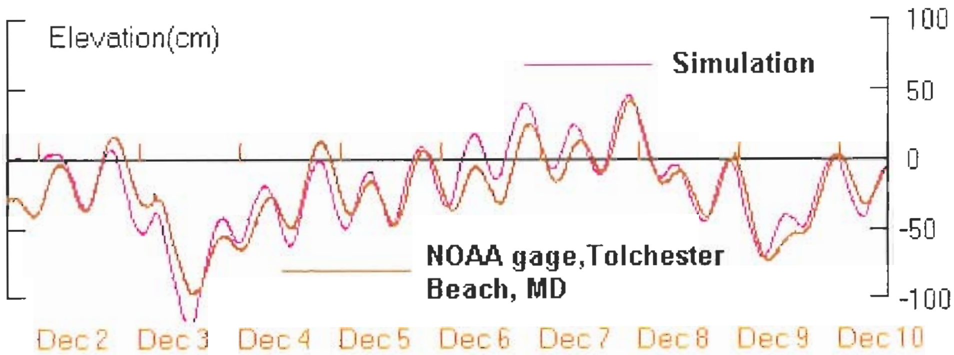

Figure 5. Comparison of model predicted and observed elevations at Tolchester Beach, Maryland.

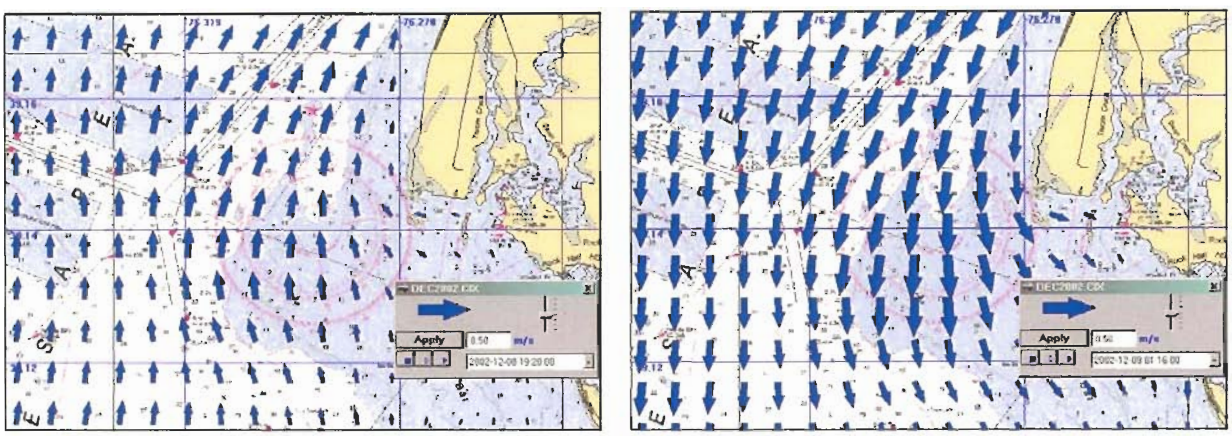

Figure 6. Example flood (left frame) and ebb (right frame) tidal flows at the dredging location.

SSFATE Model Application

SSFATE model input parameters capture best knowledge of the dredging process, including dredge production rate, sediment characteristics, loss rates (source term), vertical distribution of insertion of sediment into the water column, and settling rates of the various sediment particle size classes. Estimated source strength is a critical parameter, as is settling rate. Most of the sediment release from clamshell bucket dredging operations takes place when the bucket impinges and penetrates the substrate, and when sediment escapes as the bucket is raised through the air/water interface. Additional loss occurs when sediment overflows from the bucket, overlaying water is vented, and sediment from the side of bucket is washed off. Sediment losses associated with mechanical dredge operations have been reviewed by Hayes and Wu (2001).

Reported losses vary significantly as various individual project conditions must be considered (e.g., operational factors, sediment physical characteristics). Loss terms cannot generally be measured directly, so must be estimated based on observations at some distance from the bucket. TSS measurements are collected as close to the bucket as possible and considered in light of many other contributing factors. Reported sediment losses range from 0.16% to as high as 2.0% for an open bucket and from 0.10% to 1.5% for a closed bucket. Losses can be considerably higher if the dredged material contains large debris such as rocks that obstruct the sealing faces of the bucket and prevent complete closure of the bucket. In the Chesapeake Bay application of SSFATE, initial simulations used 2.0% loss rates.

Another major factor that controls far-field TSS concentration is how fast the sediment settles out from water column. In general, coarser materials have relatively high settling velocities and finer sediments (0-75 micron, clay and silt particles) take longer to settle out. By examining distributions of sediment type for the site, basic settling characteristics can be estimated. In the SSFATE model, the sediment distribution is represented with five distinct size classes ranging from clay particles (0-7 microns) to coarse sands (>130 microns). Initial model runs used particle size distributions based on known properties of pre-dredging sediment cores (50% clay, 25% fine silt, 20% medium silt, and 5% fine sand).

Results of these initial simulations produced a wide disparity between predicted (SSFATE) and observed (ADCP) dispersion patterns, with the model results being very conservative, i.e., spatially larger and higher overall concentrations. A series of model runs ensued evaluating the sensitivities of the various input parameters. It quickly became apparent that settling rates largely governed spatial footprints of simulated plumes, whereas sediment loss terms had greatest effect on overall TSS concentrations of simulated plumes. Closest matches between simulated and observed plumes were obtained with loss rates of 0.5%, and using settling rates for particles in the fine to coarse sand size categories. In essence, the model had to treat fine particles as much larger diameter particles before model output resembled plumes observed in the field. Given the prevailing salinity conditions of the study area, one probable explanation is that clay and silt particles flocculated, thereby behaving as larger particles.

SSFATE Modeling Results

Figure 7 depicts a composite contour plot of maximum TSS concentration predicted by the initial SSFATE model run across tidal cycles for 48 hours of simulated dredging. The simulated plume footprint is superimposed on ADCP transect lines (flood in red, ebb in black). Notable are the extensions of high concentrations, indicated by contours in red-green-light blue, well beyond the most distant ADCP transects from the source. Simulated plume signatures following calibration single flood and ebb tides are shown in Figure 8. In these examples higher simulated concentrations are confined to the ADCP survey limits. Contours in dark blue represent concentration less than 30 mg/l, which correspond to ambient conditions. Deflection of the simulated plumes as compared to overall trajectories of the ADCP-detected plumes is related to severe prevailing wind conditions during sampling.

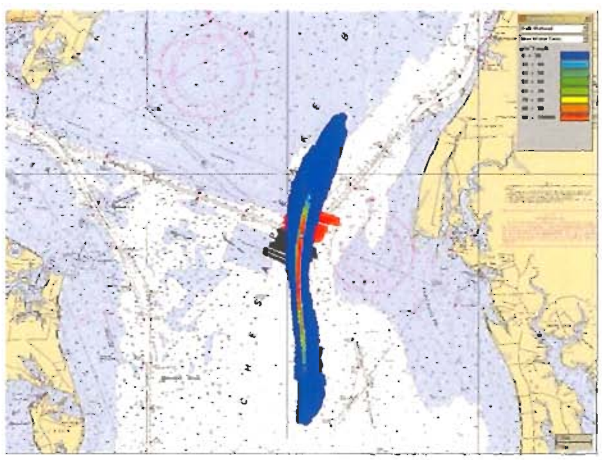

Figure 7. Maximum dredging-induced suspended sediment concentration predicted by initial SSFATE model run.

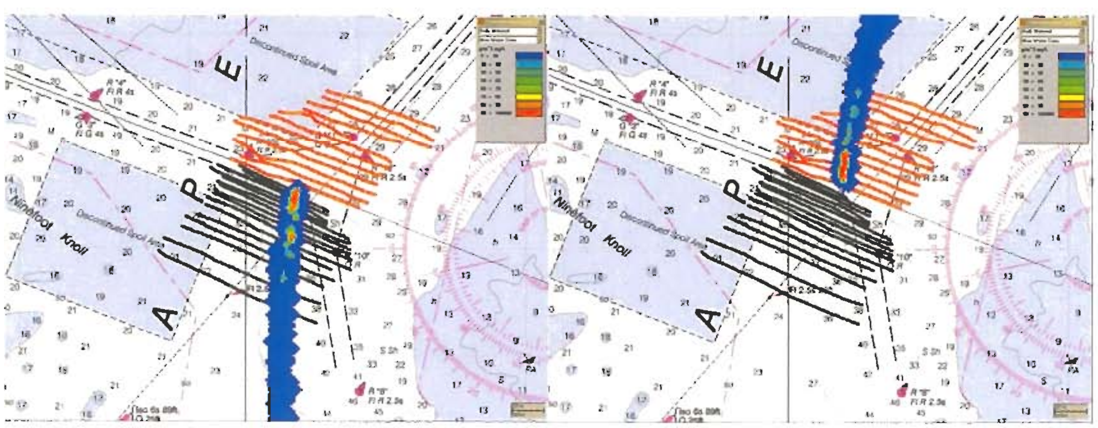

Figure 8. Maximum suspended sediment concentration during ebb (left) and flood (right) tides predicted by SSFATE after calibration.

APPLICATION TO DREDGED MATERIAL DISPOSAL OPERATIONS IN SAINT ANDREWS BAY, FLORIDA

The principal concern in Saint Andrews Bay stemmed from potential impacts of open-water dredged material disposal activities on nearby submerged aquatic vegetation (SAV) resources due to either accelerated sedimentation rates on the seagrasses themselves or to chronically elevated turbidity and consequences on long-term health of the beds.

The study area is depicted in Figure 9, which represents a portion of National Oceanic and Atmospheric Administration nautical chart 11391. Primary areas of interest for this study included the dredging location, indicted in dark brown, and the dredged material placement area, indicated in light brown. Locations of seagrass beds in the project area are given as a GIS layer with beds of different densities shown in red, light green, and dark green.

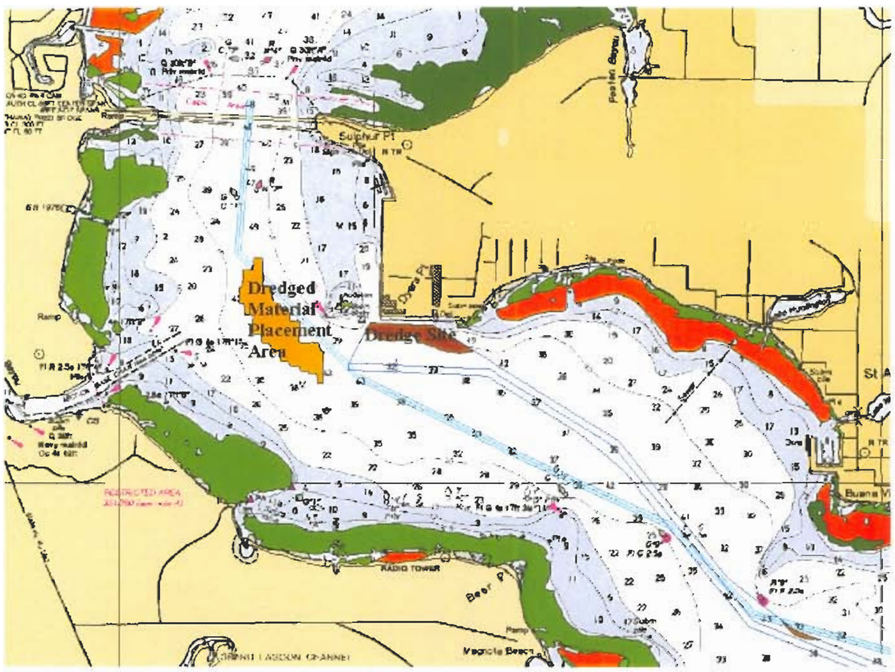

Figure 9. Map of the study area showing the dredging site and dredged material placement area.

During-dredging surveys were conducted while the Inland Dredging Company 26 inch hydraulic cutterhead Dredge *Kelly L* was performing maintenance dredging (Figure 10 left). The pipeline terminus consisted of a modified spill barge with a down-turned pipe (Figure 10 right). To minimize turbidity and suspended sediment release to the water column, the down-turned pipe had an extension that lowered the actual point of discharge to a depth of approximately 4.2 m. The pipe terminus was also fitted with a submerged diffuser (i.e. a horizontal baffle plate with a central hole) to reduce energy in the downward jet of sediment/water slurry.

Figure 10. The hydraulic dredge *Kelly L* with the cutterhead raised (left photo) and the down-turned pipeline terminus at the spill barge (right photo) with dredge visible in background.

ADCP Surveys: As in the Chesapeake Bay field study a series of ADCP surveys were taken during different tidal conditions. Eleven flood, four ebb, and three slack tide ADCP surveys were conducted during active disposal operations. Survey allocations were predicated by the fact that ebbing tides occurred primarily at night. Ambient conditions were surveyed three times. Transects were established in a manner similar to that used in Chesapeake Bay. The distance between transects was generally 30 m in the immediate vicinity of the discharge area in order to increase resolution of the plume, and 60 m in the far-field. The spatial scales of all plumes were found to be extremely consistent, i.e. little variation in length, width, vertical structure, and trajectory was noted between surveys. The number of transects occupied varied from 13 to 19 among surveys. Water samples were collected at predetermined depths for backscatter to TSS concentration conversion as described previously. Suspended sediment estimates above 15 mg/l derived from Sediview were considered above ambient.

Measurements taken with multiple OBS sensors indicated ambient turbidity levels between 1 and 3 NTU. OBS sensors deployed in the direction of plume movement indicated that the surface component of the plume exceeded ambient turbidity levels by 8 to 10 NTU at a range of 200 m from the disposal site. Mid-water OBS sensors had similar results in that ambient conditions were exceeded by 8 to 13 NTU, although one short-lived plume did exceed ambient levels by 28 NTU. Turbidity levels were markedly higher at deep-water OBS sensors. Maximum turbidity spikes of 40 to 75 NTU were common, and rarely as high as 167 NTU.

Within 50 m of the discharge, the plume was typically less than 100 m in width. Lateral spreading of the plume did occur along the bay bottom with distance, as material settled down current. Maximum width of any plume signature in this study was 350 m, typically occurring at distances from 100 to 200 m from the source, and consistently found within the lower 3 m of the water column. Highest concentrations within these plume signatures were limited to a relatively small central portion of the settling plume.

Maximum concentrations (150-200 mg/l) estimated by Sediview within 30 m of the discharge point were consistent with water samples analyzed gravimetrically. All ADCP surveys indicated a rapid settling of suspended sediments within a relatively short distance of the point source (Figure 11). Some variation was noted between surveys. Routinely, TSS concentrations ranged from 50 to 100 mg/l at a distance of 100 m from the source or approximately 35 to 85 mg/l above ambient conditions. By 200 m, concentrations decreased to 40 to 60 mg/l and were frequently less than 30 mg/l or 15 mg/l above ambient by 300 m. The silhouette of the decaying plume signature detected above ambient conditions dissipated within 400 to 700 m, predominantly less than 10 mg/l above background (Figure 12). Additional information on the field sampling program can be found in Reine et al. (2003b).

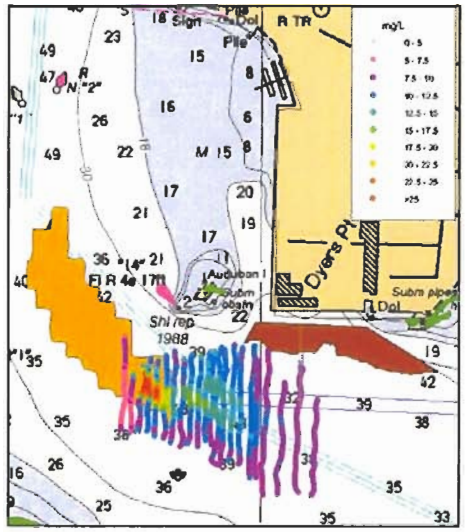

Figure 11. Plan view of open-water discharge plume during an ebb tide.

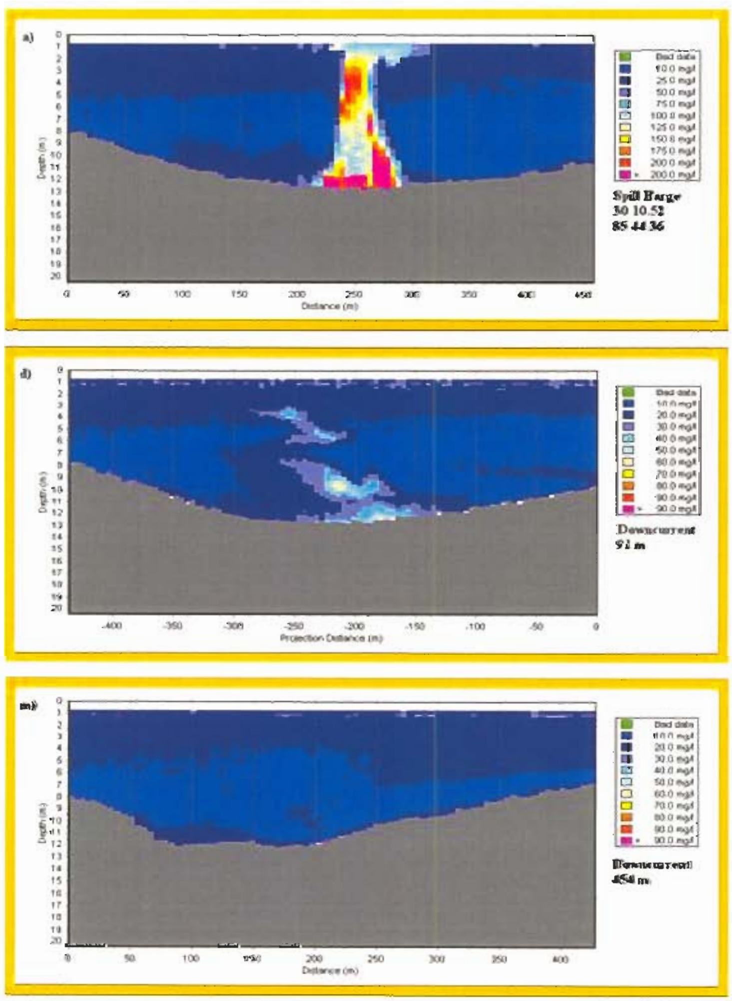

Figure 12. Vertical sections through a typical open-water discharge plume during an ebb tide at increasing distances downstream from discharge.

HYDROMAP Model Application

The HYDROMAP utility was used to generate a 5-level spatial grid, with offshore cells at a 1.0 km resolution, proceeding to 62.5 m spatial cells at the dredging project site. Appropriate for the Saint Andrew system during the study period, no river discharge was applied. Model runs encompassed the period from 1 February through 1 March 2003. The Oregon State University TOPEX tidal data set was used to derive current flows. The bathymetry data used in the model were taken from available NOAA digital charts. Surface winds were minimal throughout the study period.

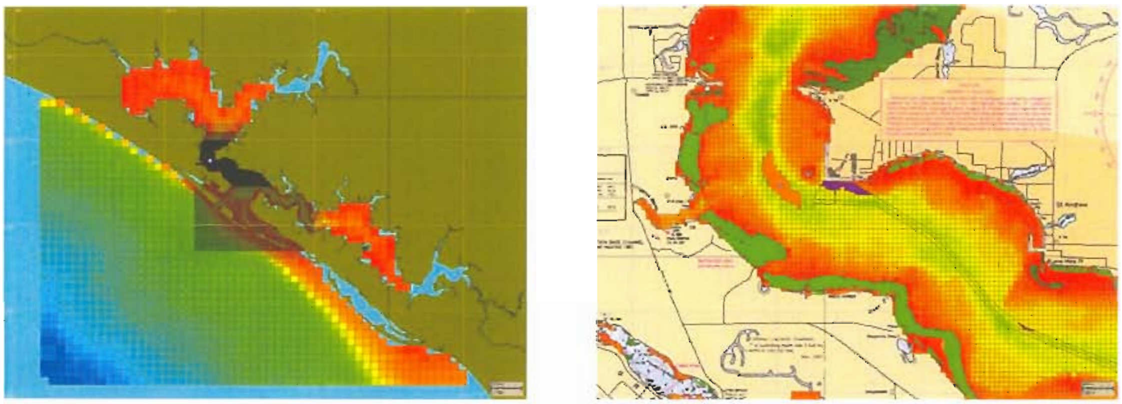

Figure 13. Hydrodynamic model grid for St. Andrews Bay. Model domain at left, project site at right.

The hydrodynamic model was calibrated using data obtained from ADCP surveys covering the entire project area. HYDROMAP generated circulation patterns that closely matched flows in terms of velocities and vectors, including eddies that formed during portions of the flood and ebb tidal cycle.

SSFATE Model Application

Pre-dredging sediment core data were used to estimate sediment particle size distributions for initial SSFATE scenarios. These data indicated that the dredged material would consist of a mixture of approximately 30% clays and silts and 70% sands. During collection of water samples at the discharge point it became clear that the discharge contained a much smaller fraction of fines, estimated at less than 5%. The discrepancy was probably due to the fact that the original sediment cores had been collected over six years earlier. One possibility was that fine fractions had winnowed from the deposits in the interim. The very high sand content was also apparent in the rapid formation of vertical relief during disposal, as evidenced by changes in bathymetry.

Sediment release from a down-turned pipe occurs as a jet of slurry. In this case the diffuser baffle plate reduced energy of the jet at a depth of approximately 5 m. In SSFATE the sediment was inserted into the water column evenly across five 0.5 m depth strata beginning at the depth of the discharge. No documented estimates of loss of sediment from a pipeline discharge in this configuration involving very high sand content slurries exist. For SSFATE input an initial loss of 3% was used.

Given the initial input parameters, SSFATE generated plumes as depicted in Figure 14. The spatial footprint of the plumes and deposition pattern greatly exceeded that observed with acoustic surveys. Because ambient TSS concentrations in the study area were consistently very low, generally less than 5 mg/l, the acoustic plumes readily discernable against background conditions. The substantial differences between simulated and observed plumes were again assumed to be due to a combination of an overly high loss term and underestimated settling rates. In this case, the particle size distribution used in the initial model runs were shifted inordinately toward finer fractions than actually were discharged. As performed for the Chesapeake Bay data, sensitivities of the input parameters were tested in series. In follow-up model runs the loss term that produced the closest agreement between simulation output and observed data in terms of TSS concentrations in the far-field was 0.5%. Likewise, fine and coarse sand fractions were increased substantially before correspondence was seen in the spatial extents of the simulated and observed plumes. Example results of the calibrated SSFATE scenarios are given in Figure 15.

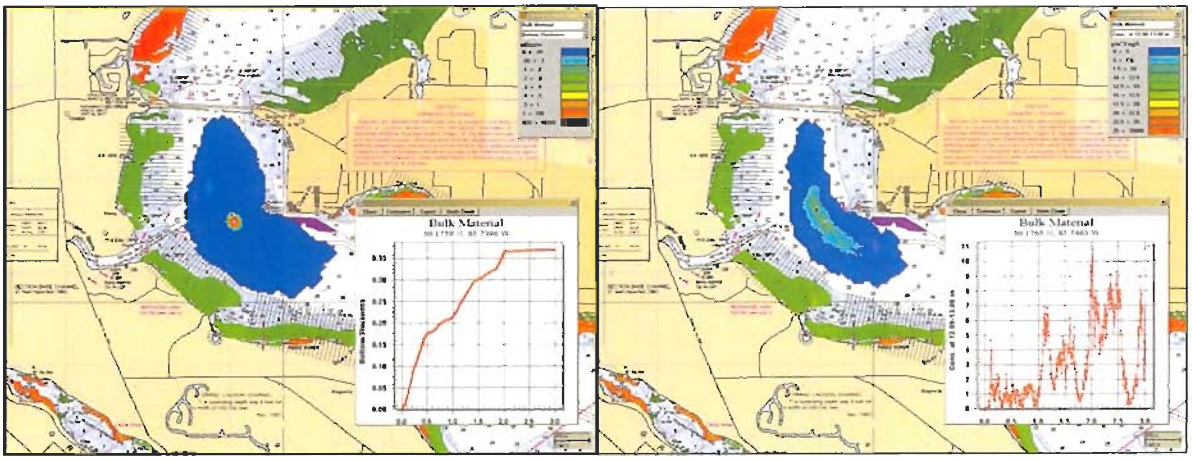

Figure 13. Initial cumulative bottom deposition pattern predicted by SSFATE (at left) with uncalibrated input. Insert shows time series of deposition at location denoted by black dot north northwest of discharge location. Maximum disposal-induced TSS concentration at a depth of 12 m predicted by SSFATE (at right) with uncalibrated input. Insert shows time series at location denoted by black dot slightly northwest of the discharge location.

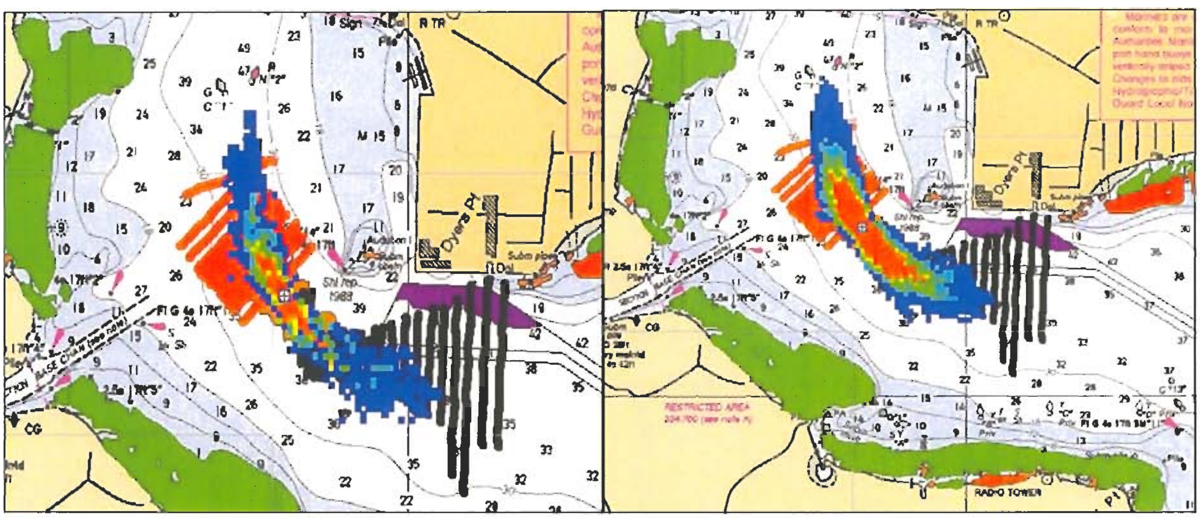

Figure 14. Maximum suspended sediment concentration at 12 – 13 m depth predicted by SSFATE after calibration (at left), superimposed on ADCP transect lines (flood in red, ebb in black). Maximum TSS concentrations at any point in the model domain after calibration depicted at right.

CONCLUSIONS

In both applications of SSFATE the initial input parameters were found to produce conservative results in terms of plume footprint and overall TSS concentrations within the simulated plumes. Field data consisting of extensive water sample collections and acoustic surveys clearly defined the actual TSS conditions and spatial dynamics of the plumes created by two very different sources. In both cases initial loss terms were demonstrated to be overestimates. For both the bucket dredging operation and the pipeline disposal project, loss terms of 0.5% produced the closest agreement between simulated and observed TSS concentrations. Settling velocities were shown to be the most sensitive SSFATE input parameter influencing the spatial extent of dispersed and deposited particles. Vertical distribution of insertion of sediment mass into the water column was found to be less important with regard to plume simulation in these applications. In both scenarios plumes decayed rapidly in the upper water column. Field data verified that the plumes generally became entrained in the lower half of the water column thereafter tended to follow bottom depth contours.

Results of these SSFATE applications are somewhat preliminary and will be explored in detail in tandem with additional applications before general guidance can be given for model applications covering diverse dredging and dredged material disposal processes. However, several implications deserve consideration. Given the number of dredging projects that give rise to environmental concerns, it is improbable that comprehensive monitoring can be supported in more than a fraction of cases. For the remainder, modeling tools offer promise to act as a means to screen those project that pose greatest risk to environmental resources. Selection of appropriate input parameters will be critical to confidence levels that can be placed in the results of future modeling applications. Technologies are at hand to provide field data to verify and calibrate model applications and to build the databases necessary to set the bounds on modeling exercises. With due care in formulating model scenarios, models such as SSFATE offer potentially powerful means to reach rational, objective, and prudent dredging project management decisions.

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Attachment 1-B

Weaver's Cove Energy, LLC
Responses to the
Federal Energy Regulatory Commission Staff's
October 15, 2004 Environmental Data Requests

Weaver's Cove Energy, LLC
Responses To The Federal Energy Regulatory Commission Staff's
October 15, 2004 Environmental Data Requests

Commission Request No. 1:

Because state and federal agencies continue to recommend dredging restrictions to protect aquatic resources in the Taunton River and Mount Hope Bay, provide an analysis of potential impacts on the proposed project if time of year restrictions are imposed on dredging activities. Specifically, assess the effect on the proposed project design, schedule, and costs if dredging is not allowed or is severely restricted during the following periods: 1) January 15 – May 31 for the winter flounder spawning period; 2) a combination of the winter flounder spawning period and March 1 – July 31 for the anadromous fish upstream migration period (i.e., January 15 – July 31); 3) a combination of the winter flounder spawning period, the anadromous fish upstream migration period, and June 15 – October 31 for the anadromous fish downstream migration (*i.e.*, January 15 – October 31). Also, we encourage Weaver's Cove Energy to propose alternative dredging or disposal measures to mitigate impacts on the project schedule and costs (*e.g.*, no scow overflow, closed buckets, offshore disposal etc.).

Response:

A. Impacts of time of year restrictions: The first part of this request calls for "an analysis of potential impacts on . . . the proposed project design, schedule, costs if dredging is not allowed or is severely restricted" during certain periods associated with the identified fisheries resources.

In the course of their DEIS review, a number of agencies and members of the public have expressed concerns regarding Weaver's Cove's dredging plans, which they have mistakenly characterized as occurring 24 hours per day, seven days per week, continuously, for three years (1,095 days). This is simply not correct, and has lead to many misconceptions about the need for time of year dredging restrictions. As summarized below, Weaver's Cove outlined in its original application a specific dredging program that did not call for this continuous level of dredging. *See* December 19, 2003 Application, Volume II-C, Exhibit F, Attachment A (the "Dredging Program Report"). The dredging program is based on estimated optimal production rates specific to the various areas to be dredged, and also gives recognition to the rate of upland placement, which will vary depending on the time of year and other factors. For example, a large dredge (26 cubic yard (CY) bucket) removing the thick layer of relatively soft depositional sediments in the turning basin could excavate 8,000 to 10,000 CY per day (in situ). In this area, relatively little time is spent repositioning the dredge, so production rates would be high. Put in perspective, a 26 CY bucket, assuming an 80% load and operating on a 90 second cycle time, could remove 10,000 CY of sediment in about 12 operating hours (which are not equal to consecutive clock hours because of time-consuming variables such as equipment maintenance, fleet repositioning, *etc.*) from the turning basin. Conversely, a dredge using a smaller bucket (7 or 15 CY bucket) working to remove a thin layer of sediment along the edges of the channel south of the Braga Bridge might produce only 2,000 CY per day. In this same four-mile plus section of the channel, the dredge fleet will be repositioned frequently due to the thin cuts involved. (Dredging Program Report at pp. 40-41.)

The dredge plan, as previously outlined, includes:

Channel south of the Braga Bridge, 2,000 CY/day, 300 days +/-
Channel north of the Braga Bridge, 4,000 CY/day, 150 days +/-
Turning Basin, depositional sediments, 8,000 to 10,000 CY/day, 100 days +/-
Turning Basin, native sediments, 5,000 to 7,000 CY/day, 70 to 100 days +/-

Total: 650 days +/- of operation distributed along the nearly seven-mile long channel/turning basin, conducted over a period of roughly 3 years (1095 days)

The daily rates shown above are estimates of dredge production on a good day (a single dredge, no significant equipment problems, acceptable weather, skilled crews, *etc.*). Dredging rates can be predicted with some certainty, because dredging projects using similar equipment to that being proposed and in similar environmental conditions to the conditions in the Taunton River are executed around the world on a regular basis.

However, the same cannot be said with regards to the dredged material stabilization and placement work. Simply put, the stabilization and placement rates are not as predictable. Based upon the extensive work required to stabilize large volumes of dredged material using cement and then place it upland in a sculpted landform on several dozen acres of land, the predictability of dredged material placement rates is much less than for the dredging itself. This is not to imply the work is very complex, but the three year timeframe envisioned by Weaver's Cove gives due recognition to the fact that the schedule must incorporate down time for weather delays, possible equipment problems, and other possible schedule limitations associated with *the integration of* the dredging operation and the upland placement operation. Weaver's Cove would suggest conservatively for planning purposes that at least 50% additional time should be allotted to account for these factors. While this allowance may seem large, schedules associated with dredging may not coincide with schedules associated with stabilization and upland placement and, as a result, the time frames from each activity could be largely additive.

As stated repeatedly in the permitting record before this Commission and other agencies, Weaver's Cove will need to match dredge production rates to the rate at which the material can be brought on site, stabilized, placed and compacted. The controlling factor of the dredge schedule is the pace of the on shore placement work, not the dredging itself. More specifically, the higher dredge rates (7,000 to 10,000 CY/day, in the turning basin) would be scheduled during the warmer, dryer parts of the year (May through October) when the rate of placement should also be at its highest. Therefore, the loss of a warm summer day to a dredging window could have more impact on the overall dredging program than the loss of a cold wet winter day. For corresponding reasons, the slower dredging work would be scheduled for the colder, generally wetter months (trusting that the permits allow this flexibility), when the rate of placement will likely be at its lowest. The slower dredging work should also be scheduled to correspond to the later stages of the on site placement work (*i.e.,* construction of the upper portions of the landform – again trusting that the permits allow this flexibility), when the rate of placement and compaction will likely be at its lowest given the logistical limitations imposed by the site conditions. At these later stages of the dredging/placement project, construction crews will be working in a smaller area and thus will be less capable of handling large volumes (10,000 CY/day) of material, and will have less flexibility (i.e., less stockpiling space and less material handling space).

None of this information is new. It is being restated here in the interest of correcting misperceptions that have developed as to the realities of the dredging schedule, and to help explain how dredging windows, if they need to be applied, will impact the project schedule. The dredging windows that have been suggested can be summarized in the following table:

Window Period	January 15-May 31	January 15-July 31	January 15-October 31
Days excluded/year	136	197	258
Dredging Days available/year	229	168	107
Dredging Days available over three years	687	504	321

While the table above shows the number of dredging days that would be available for each of the window scenarios suggested by NOAA Fisheries, for example, all days throughout the year should not be given equal weight. The Dredging Program Report, Section 7.3, details the necessity of sequencing the dredging-stabilization-placement activities and the seasonal implications to offshore and landward production rates must be recognized. On a warm, dry summer day it should be possible to stabilize and place roughly 7,000 to 10,000 cubic yards. On a cold, windy, and wet winter day it might not be possible to place even 2,000 cubic yards. In addition, the Dredging Program Report at Section 7.2.4 makes clear that the placement rate should be higher early in the development of the project when there is more land available to place the material. Later in the land development and earthworks, the bulk of the land will be filled with plant equipment and consumed by the side slopes for the sculpted landforms. Thus, a warm summer day in year one will permit a much higher dredging and placement rate than a warm summer day in year three of the construction program.

The significance of this background explanation is that if the project is forced to dredge south of the Braga Bridge on a warm summer day then a single dredge will not be able to remove 10,000 cubic yards a day because the cuts are thin, the buckets are small (because the cuts are thin), and much time is spent repositioning the equipment. In the end - while the numbers can be studied and various projections can be made – the reality of the situation is that there are many variables to consider and they may not all interact in a predictable fashion. As another example, starting the project in the Spring might have a different impact on the dredging program compared to starting the project in the late Fall.

Schedule uncertainty is nothing new or onerous, it simply needs to be incorporated into the planning process. Taking an optimistic set of assumptions and projecting them forward will result in difficulties executing the assumed project schedule, and will give the project less ability to control environmental impacts in an optimum fashion. Weaver's Cove would note that a recently completed offshore pipeline project ran into scheduling difficulties in part, it appears, because optimistic planning factors were not tempered by pragmatic scheduling terms.

With the above background information, a review of the impact on the project of each of the window periods identified above is as follows:

1) January 15 - May 31: This window option would result in a dredging program with 687 available days over a three year period. It is highly unlikely that the dredging program could be completed in a three year program with this restriction in place. Bringing additional dredges onto the job would probably not help as the bottleneck would be the upland placement operation, unless a large number of barges were filled and moored for an indefinite duration. The loss of the latter part of the month of April and all of the month of May would have a severe impact as these would otherwise be the relatively high production rate months. Offshore placement of dredged material (native and non-native) would be required to assure a three year construction schedule as discussed further below, but would in turn require the mobilization and operation of multiple dredges. Cost impacts of mobilizing and demobilizing the dredge fleet around the dredge windows could run to millions of dollars.

2) January 15- July 31: This window option would only provide for a dredging program with 504 available days over three years. This option would therefore probably need to be executed over five years if upland disposal only was used. The loss of all of the Spring and one summer month would eliminate a good portion of the high production rate (upland placement) months. And, again, both native and non-native sediment would have to be placed offshore to maintain a three year construction schedule, using multiple dredges. Cost impacts of mobilizing

and demobilizing the dredge fleet around the dredge windows likewise could cost millions of dollars, and would be even higher than in the previous case given the probable need either for more dredges or an extended dredging program.

3) January 15 - October 31: A dredging program that only includes cold weather months and utilizes upland placement of dredged material clearly will take several additional years to complete even beyond the five year estimates described above. A rough estimate is that such a program might run seven to nine years and would essentially be impractical for the project to achieve. Again, both native and non-native sediment would have to be placed offshore to get back to a three year construction schedule. The costs could, obviously, be correspondingly greater.

As noted, placing most or all of the dredged material in an offshore disposal site would relax the schedule constraints somewhat, and would allow multiple dredges to work in the channel at certain times of the year, since the offshore disposal option does not carry the same "placement" constraints as the upland placement program. In that regard, the dredged material must be demonstrated to be suitable for offshore disposal. The Tier II sediment testing program completed by Weaver's Cove demonstrates that the chemical composition and grain size of the "non-native" (maintenance) sediments are similar across the various areas to be dredged, and exhibit mild contamination. No hot-spots or areas of significantly elevated contamination were found in the sediment samples. The Tier II testing also has shown that the chemical and physical compositions of the native sediments to be dredged within the dredge footprint are uniform, are cleaner than the non-native sediments (showing little or no contamination), and are expected to prove acceptable for offshore disposal. The test results also show that the native sediments are different chemically and physically from the non-native sediments. Given the consistency of the composition within the two classes of sediments, it is likely that each class will either pass or fail the Tier III testing as a whole and be shown to be acceptable (or unacceptable as the case may be) for offshore disposal. (The feasibility of offshore disposal of all or a portion of the dredged material is also discussed on pages 4-4 through 4-5 of the SDEIR) (copies attached).

As a result, it is reasonable to conclude that the most probable outcome of the Tier III testing will be one of two situations: (1) all the sediments, native and non-native are suitable for offshore disposal; or (2) only the native sediments are suitable for offshore disposal. If the outcome of the yet-to-be-completed Tier III testing is assumed to fall into one of these two most probable outcomes, a more focused and realistic analysis of the offshore disposal options can be developed. Any materials (up to 2,600,000 CY in situ) which are suitable for offshore disposal, would likely be placed in the Rhode Island Sound Dredge Disposal Site (earlier characterized as "69b"). As described in the DEIS, for the Rhode Island Region Long-Term Dredged Material Disposal Site Evaluation Project prepared by the EPA in cooperation with the USACE, New England District, this site measures approximately one nautical mile by one nautical mile in plan. It is located approximately nine nautical miles south of Point Judith, and is in water depths of

115 to 128 ft. The site has an estimated disposal capacity of 20,000,000 CY. The site has reportedly received approximately 2,800,000 CY of material from the Providence Harbor project since 2003. The EPA has estimated the life of the site to be approximately twenty years.

The potential environmental impacts from disposal of some or all of the Weaver's Cove dredged material would be expected to be addressed analogously in light of the extensive review of the impacts studied for the Providence River Dredging Project. These environmental impacts were well researched and documented in the EIS for that project.

Some commentors have focused on the potential for full or partial offshore disposal as providing an opportunity to adjust the timing of the Weaver's Cove proposed dredge program and impose more stringent dredging limitations than the proponent has proposed. If only the native materials are suitable for offshore disposal, Weaver's Cove believes the impacts on the dredging schedule will be relatively minimal as discussed below.

In this scenario, all the non-native material would be stabilized with cement and placed upland, while the native material would be placed offshore. The volume of native sediment has been estimated to be approximately 615,000 CY (in situ), or approximately 20 to 25% of the planning total. The actual number will vary somewhat based on how much overdredge is removed, as described in the October 29 Response at pp. 93-96 (copies attached). As stated in the existing permitting record, the bulk of the native material is located in the turning basin area. The studies completed by ASA with regards to sediment dispersion resulting from the dredging of the native sediment demonstrated that some equipment restrictions (*i.e.* 15 CY bucket, no scow overflow) would be needed when dredging this material during the winter months so as to avoid potential impacts on winter flounder spawning. A more likely scenario is that the native materials would be dredged at a relatively high rate (5,000 to 7,000 CY/day or perhaps more) during the warmer weather months. At these rates, dredging of the native materials would take on the order of 90 to 120 days. If off shore disposal were to be used, the dredge rates could be doubled and the overall duration could be reduced to 45 to 60 days. In the context of a dredging program of approximately 650 days at full production rates (over an elapsed time of three years), a reduction of 30 to 60 days (10 to 20 days per year) would not afford much additional scheduling flexibility. Weaver's Cove therefore believes that this is not feasible or reasonable. The environmental impacts of the dredging operation were conservatively estimated assuming the dredge is operating at optimal production rates, but exceeding the modeled production rates will lead to higher sediment loadings in the waters around the dredge – in the final analysis, the production rates cannot be doubled without resulting in increased in-water environmental impacts and, at some point, this may in turn limit what can be dredged and at what rate.

It also is important to note that the Dredging Program Report clearly stated that stabilization and placement of native (coarse grained) materials upland is easier, faster, and cheaper than placing non-native maintenance sediments upland. Therefore, the schedule may not improve as dramatically as one might hope by taking native sediments offshore.

On the other hand, if all the dredged materials prove acceptable for offshore disposal, Weaver's Cove could consider accepting more limitations, including more restrictive dredge windows. While schedule is a driving factor in any project, costs cannot be totally ignored, as evidenced in Dredging Program Report at Section 9.5. The cost of taking material upland to the LNG Terminal site is presently estimated to fall somewhere between $35 and $55 per CY. The cost of offshore placement into the offshore site discussed above will be roughly $12 to $18 per CY. Clearly, there are cost savings associated with taking materials offshore, but these must be balanced against the costs of mobilizing and demobilizing the additional dredging fleets, and the associated down time that would be required to maintain the three year schedule in the face of highly restrictive dredging windows. The cost benefit from taking the material offshore must also be offset by the cost of bringing replacement material on-site in order to create the site conditions which Weaver's Cove is aiming to achieve – a significant layer of material above the present site elevation to reduce the construction risk associated with the site, and the material needed to create the sculpted landform.

Each of the three dredging window scenarios (described above) can be managed to meet the overall project schedule consistent with the design proposed in the Weaver's Cove application if 100% offshore disposal proves feasible. However, the potential environmental impacts will involve trade-offs between production rates and suspension of sediments in the water column. The cost impacts also involve trade-offs which are not straightforward, and the more restrictive dredging windows with limited or no offshore disposal could threaten the project's financial viability. As more material is moved offshore to preserve the schedule, soils and other fill materials will have to be imported onto the site to support the site grading plan and to create the landform, which in turn will involve further trade-offs with material costs and additional off-site trucking and other environmental impacts.

The design of the proposed LNG Terminal will not change dramatically under any of the scenarios discussed above. The site needs to be re-graded to support the development of LNG impoundment systems (LNG tank, LNG truck loading area, LNG piping areas), a barrier between the existing soils and the new ground surface is required under the deed restrictions due to the brownfield nature of the site, and a sculpted landform will be used to screen the LNG Terminal from the abutting landowners. The remediation system will still need to be operated during and after construction, and new production and monitoring wells may still have to replace some of all of the existing wells.

In conclusion, the tradeoffs involved with the potential use of dredging windows and time of year restrictions focus more on project cost, project schedule, and potential environmental impacts associated with in-water operations, as opposed to project design or potential upland environmental impacts. Weaver's Cove has also consistently agreed that unfettered dredging operations throughout the year are not acceptable. Using sound scientific principles and analysis, Weaver's Cove believes that its numerous studies have demonstrated that dredging windows and time of year restrictions that force shutdown of the dredge fleet do not provide additional protection for the environment above that in the filed program. It appears that the environment can be protected by placing reasonable restrictions of the type and size of dredging equipment, as well as implementing operational restrictions on the dredging program, as discussed below.

B. Mitigating Measures: In this request, the Commission Staff also encourages Weaver's Cove to propose alternative dredging or disposal measures to mitigate the above-described impacts on project schedule and costs. It should be noted that Weaver's Cove sees these alternative measures as being more for the purpose of appropriately mitigating impacts to the identified resources, rather than as measures to mitigate impacts to the project development schedule and costs. While Weaver's Cove continues to see these alterations/restrictions as permitting issues to be established during the USACE application process, such as now underway to explore the feasibility of the offshore disposal option, nevertheless Weaver's Cove has previously indicated its willingness to explore and adopt such measures in this permitting process. In that regard, at pages 138-139 of its October 29 Response (copies attached), Weaver's Cove has outlined some of those measures. These include such measures as time of year restrictions in certain areas, limits on scow overflow, and use of closed buckets in certain areas and at certain times. *See* also the SDEIR at pages 1-14 through 1-16 (copies attached).

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the Providence River dredging project. Some commentors have focused on the potential for full or partial offshore disposal as a means to adjust the timing of the proposed dredge program. If only the native materials are suitable for offshore disposal, Weaver's Cove believes the impacts on the dredging schedule will be relatively minor as discussed below. In this scenario all the non-native material would be stabilized with cement and placed upland, while the native material would be placed offshore. The volume of native sediment has been estimated to be 615,000 cy (in situ) or about 20 to 25% of the planning total. The actual number will vary somewhat based on how much overdredge is removed.

As stated in the existing permitting record, the bulk of the native material is located in the turning basin area. The studies completed by ASA with regards to sediment dispersion resulting from the dredging of the native sediment demonstrated that some equipment restrictions (ie 15 cy bucket, no scow overflow) would be needed when dredging this material the winter months so as to avoid potential impacts on winter flounder spawning. A more likely scenario is that the native materials would be dredged at a relatively high rate (5,000 to 7,000 cy/day or perhaps more) during the warmer weather months. At these rates, dredging of the native materials would take on the order of 90 to 120 days. If off shore disposal was to be used, the dredge rates could be doubled and the overall duration could be reduced to 45 to 60 days. In the context of a dredge program of approximately 650 days at full production rates (over an elapsed time of 3 years), a reduction of 30 to 60 days would not afford much additional flexibility on scheduling.

As envisioned in the original dredging program, native sediments were slated to be removed at a fairly rapid pace, between 5,000 and 7,000 cubic yards per day during the summer months. If these materials are not taken upland but instead they were taken offshore, Weaver's Cove estimates the extraction rates might double to 10,000 to 14,000 cy/day. It should be noted that higher production rates lead to higher sediment loadings in the waters around the dredge – thus one cannot double production rates without having increased in-water environmental impacts and, at some point, this may limit what can be done in the water.

4.3 Marine Fisheries

Exhaustive modeling of fisheries impacts resulting from dredging operations has been performed by Applied Science Associates, Inc. (ASA) on behalf of Weaver's Cove Energy. Subsequent to the publication of its report "Modeling Dredging-Induced Suspended Sediment and the Environmental Effects in Mount Hope Bay and the Taunton River for the Proposed Weaver's Cove Energy, LLC Liquefied Natural Gas Import Terminal" (dated December 2003, and submitted in conjunction with the Project's December 19, 2003 FERC application), ASA has supplemented its initial findings in response to fisheries agencies' requests to analyze impacts based on different assumptions on repeated occasion.

ASA's reports have been appended to numerous environmental review permit applications, including the US Army Corps of Engineers Section 404/10 permit, the Section 401 Water

Attachment 2

Weaver's Cove Energy, LLC

Proposed Balanced Dredging Mitigation Plan

Weaver's Cove Energy, LLC
LNG Import Terminal and Connecting Pipelines
Fall River, Massachusetts

PROPOSED BALANCED DREDGING MITIGATION PLAN

June 8, 2006

Weaver's Cove Energy, LLC ("Weaver's Cove") received approval from the Federal Energy Regulatory Commission ("FERC") in July of 2005 to construct and operate a proposed new LNG receiving terminal on the Taunton River in Fall River, Massachusetts. To facilitate the transit of LNG ships to the Terminal, Weaver's Cove proposes, at its expense, to perform certain maintenance and improvement dredging operations in the existing Mount Hope Bay/Taunton River Federal navigational channel and existing Federal Turning Basin. The Weaver's Cove dredging proposal also includes a small extension of the existing Turning Basin and an open cut pipeline crossing immediately upstream of the Turning Basin. FERC conditioned its July 2005 approval upon Weaver's Cove's receipt of a dredging permit from the U.S. Army Corps of Engineers ("USACE").

On March 18, 2004, Weaver's Cove filed its Section 10/Section 404 Individual Permit application with the USACE. The application was subsequently amended to include Section 103 approval for ocean disposal of suitable sediments. During the course of the USACE review process, two public notices were issued and four separate public hearings were held. Certain participating Federal agencies have filed comment letters[1] requesting a variety of time-of-year ("TOY") restrictions on dredging. On May 17, 2006 Weaver's Cove filed a comprehensive response to these comments in a document entitled "Responses to Comments, Review of Public Interest Factors and Compliance with Section 404(b)(1) Guidelines."

In order to bridge the differences as to TOY restrictions between Weaver's Cove and the various agencies, Weaver's Cove offers this Proposed Balanced Dredging Mitigation Plan. This Proposal is based on the science in the record and addresses agencies' concerns by providing reasonable and effective protections to identified marine species in the dredging area, while providing Weaver's Cove with a workable set of measures.

I. SUMMARY OF PROPOSAL

Weaver's Cove is prepared to adopt a comprehensive, balanced solution that protects the marine environment, is fully consistent with recent practice adopted in other major dredging projects in New England, and which will allow dredging to proceed within a workable and achievable schedule. The Proposal includes many of the major

[1] September 17, 2004 - U.S. Department of the Interior ("DOI") to FERC; September 22, 2004 – U.S. Fish and Wildlife Service ("FWS") to USACE; July 5, 2005- DOI to FERC; December 27, 2005 – National Marine Fisheries Service of the National Oceanic & Atmospheric Administration ("NOAA Fisheries") to USACE; February 7, 2006 – FWS to USACE.

elements that NOAA Fisheries, FWS, and other agencies have requested. These elements include:

A. **Seasonal Dredging Restrictions**: Dredging operations would not be allowed for significant portions of the year due to specific biological activities that occur during those seasons. Where appropriate, somewhat less severe restrictions are proposed for the open waters of Mount Hope Bay.

B. **Dredge Equipment Restrictions and Equipment Operating Techniques**: These measures are aimed at minimizing the amount of sediment released into the water column during dredging operations and minimizing the extent of the river cross section affected by dredge-induced elevated suspended sediment levels.

C. **Mitigation Measures**: These are proposed to avoid project impacts on certain species (for example, shellfish), or to appropriately mitigate certain unavoidable project impacts (for example, potential loss of winter flounder spawning habitat).

This Balanced Dredging Mitigation Plan assumes that offshore ocean disposal is utilized by the Project for all suitable materials. Earlier Project plans had been based on upland placement of stabilized dredged material.

II. DETAILS OF WEAVER'S COVE PROPOSED BALANCED DREDGING MITIGATION PLAN

A. Seasonal Dredging Restrictions[2]

1. **Extended Winter Flounder Restriction**: A complete and extended 4 ½ month ban on dredging running between January 15 and May 31 of each year, in order to protect both winter flounder spawning (eggs and larvae).

2. **Anadromous Fish Restriction**: A complete ban on dredging in Massachusetts waters running between March 15 and June 15 of each year in order to protect the upstream migration of anadromous fish species. This restriction is in accordance with Massachusetts Wetlands Protection Act ("WPA") regulations.

3. **Extended Anadromous Fish Restriction**: An extension of the restriction for the upstream migration of anadromous fish through to July 31 in Massachusetts waters located upstream of the Braga Bridge (Interstate 195). This six-week extension of the Massachusetts WPA restriction will further protect anadromous fish species in the narrower confines of the Taunton River.

[2] With respect to dredging restrictions, the Weaver's Cove Proposal goes far beyond restrictions required for the recently completed 6,000,000 cubic yard Providence River and Harbor dredging project and the Boston Harbor dredging project.

Weaver's Cove, in consultation with NOAA Fisheries, may elect to conduct fish counts or other sampling to assess the dates(s) at which the upstream anadromous fish migration is substantially concluded. Should such data indicate that the July 31 restriction is unnecessarily restrictive, NOAA Fisheries will work constructively with Weaver's Cove to develop an alternative restriction.

4. **Pipeline Crossing Restriction**: Since dredging for the pipeline crossing will, of necessity, involve moving the dredge across the flow of the river, dredging/backfilling for the Taunton River pipeline crossing will only be conducted between November 1 and January 14. Biological activity is at a low ebb during this early winter period.

5. **Downstream Anadromous Fish Migrations**: At all other times (August 1 through January 14 in the Taunton River, June 16 through January 14 in Mount Hope Bay, below the Braga Bridge)[3], dredging will be conducted in accordance with the equipment and operating measures described in Section B (below). Because of the balance afforded by the foregoing, it is agreed that there will be no further restrictions, sequencing requirements or other limits including any such measures as previously recommended by several agencies with respect to the downstream anadromous fish migration. Following the precedent established of the nearby Providence River and Harbor Project, and as recommended by FERC in the Weaver's Cove FEIS, it will be recognized that the measures described in Section B are adequate for the protection of the downstream migration of anadromous fish.

B. Dredge Equipment Restrictions and Equipment Operating Techniques

1. **Bucket Size**: Buckets appropriate for the depth of dredge cut in a given area shall be used; buckets up to 26 CY may be used in the Turning Basin and the "S-Bend"

2. **Environmental Buckets**: Closed or "environmental" buckets shall be used in all depositional or maintenance sediments. Conventional open buckets may be used in the more resistant native sediments. A conventional open bucket may also be used in areas where excessive debris limits the effectiveness of environmental buckets.

3. **No Scow Overflow**: There shall be no deliberate scow overflow at any time.

[3] Excepting the pipeline crossing, as noted in paragraph II.A.4, above.

4. **Production Dredge Spacing**: During periods where multiple production dredges are being deployed, a minimum upstream/ downstream spacing of 1,500 feet between dredges will be maintained.

5. **Number of Dredges**: Typically, only one dredge in each of the three major reaches (the Turning Basin, the S-Bend, and the Federal Channel south of the Braga Bridge) will be operated.

6. **Dredge Movements**: In addition, dredge equipment movements will be maintained, to the extent practicable, in a direction generally parallel to the river/tidal flow (north/south) as opposed to back and forth (east/west) across the river. By working parallel to the direction of the current and tidal flows, the cross sectional area of the dredge-induced sediment "plume" will be minimized, thereby maximizing the unaffected river cross section available to anadromous fish to swim around the "plume."[4]

C. **Mitigation Measures**

1. **Salt Marsh Avoidance**: Weaver's Cove will revise the shoreline profile of the site and plant layout so as to completely avoid impacts to the 0.04 acres of salt marsh on the south end of the project site.

2. **Salt Marsh Restoration Plan**: Even though impacts to that salt marsh have been avoided, Weaver's Cove will continue to implement the previously proposed on-site salt marsh mitigation measures. These measures comprise restoration of a 0.7 acre salt marsh area currently degraded by fill material and common reed.

3. **Shellfish Mitigation Plan**: While shellfish (primarily northern quahog) are reported to be relatively abundant in portions of the dredge area, commercial harvesting is not allowed in the Taunton River and Mount Hope Bay. The shellfish in this area are biologically contaminated and unsafe for human consumption, as a result of elevated fecal coliform levels.

   Approximately 84 acres of the approximately 160-acre dredge footprint in Massachusetts has been mapped by the Massachusetts Division of Marine Fisheries ("MADMF") as potential habitat for northern quahog. An additional 11.5 acres of potential northern quahog habitat may exist in the approximately 33-acre dredging footprint located in Rhode Island waters (this area is also closed to shellfishing).

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[4] This will not be possible during dredging of the pipeline crossing (estimated volume of 33,000 cubic yards out of a total project planning volume of 2,600,000 cubic yards, hence the pipeline dredging will be conducted in the November 1 – January 14 period.

Although the shellfish within the dredge footprint are not available for commercial harvest or human consumption, Weaver's Cove has developed a plan to mitigate the one time loss or relocation of shellfish stocks which would result from the dredging work. The performance based plan includes the following elements:

- Pre-Harvest Survey – a pre-harvest survey will be conducted for the mapped MADMF areas within the dredging footprint. The survey will establish relative abundance and location of quahogs so that it can be determined if a potentially commercially-harvestable quantity exists. The results of the pre-harvest survey will define the locations from which pre-dredge harvesting will occur.

- Harvest and Relay – The purpose of the shellfish harvest and relay phase is to remove and transfer potentially commercially-harvestable quahogs that may be directly impacted by the dredging project. By removing the quahogs and relaying them to suitable off-site locations, impacts to the existing (and currently restricted) resource will be minimized. As a result, those shellfish resources can continue to grow, depurated if moved to less contaminated areas, and then harvested for human consumption.

- Seeding – Following the dredging work, shellfish seeding will be conducted. The shellfish seeding is expected to boost natural regeneration and shellfish propagation in suitable habitats.

- Post-Seed Monitoring and Compliance with Success Criteria – During the pre-harvest survey, prior to the start of dredging in each dredging element, shellfish sampling will be performed to determine the numbers and weight of quahogs per unit area, as well as the sediment grain size distribution. As the quahogs are harvested for relay, the numbers and weight of clams in defined areas will be recorded. Growth data (shell length versus age) available from University of Rhode Island researchers (Rice et al., 1989) will be used to determine the median age of quahogs present. Following the dredging work, seeding will be performed. Subsequently, the areas will be re-surveyed to determine the biomass present. Statistical analyses will be used to determine if the biomass present in the number of years after seeding is equivalent to (i.e., not significantly different from) the pre-dredging condition. If the biomass is significantly lower, an analysis will be made of the habitat characteristics (grain size and physical-chemical) of the seeded areas to determine if they are suitable for quahogs. If those areas are deemed suitable, additional seeding will be performed. If an area is deemed not suitable, other mitigation sites will be used (e.g., areas where harvesting such as the ongoing relays has occurred). Weaver's Cove will consult with MADMF on these evaluations. Once the biomass has reached the pre-dredging level, the area will be considered restored.

Weaver's Cove maintains that the proposed shellfish mitigation plan will adequately compensate for any Project-related impacts to quahog habitat.

4. **Mitigation for Winter Flounder Spawning Habitat in the Turning Basin Expansion Area**

Weaver's Cove will finalize, in good faith consultation with NOAA Fisheries, FWS, the National Park Service ("NPS"), the U.S. Environmental Protection Agency ("EPA") and USACE, via the USACE permitting process, the winter flounder habitat mitigation plan. Recognizing that in-kind replacement of 11 acres of winter flounder habitat is not practicable, the agencies will work constructively with Weaver's Cove to finalize an alternative mitigation option(s).

NOAA Fisheries has estimated that approximately 11 acres of the river bottom that will be dredged to a depth of 41 ft (~12.5 meters) MLLW will no longer be suitable for winter flounder spawning. This analysis is based strictly on water depth, without consideration of bottom conditions and suitability of existing exposed sediment type for winter flounder spawning.

On May 20, 2005, Weaver's Cove submitted for agency review, a proposed mitigation plan for these impacts. Because there are no meaningful opportunities for on-site, in-kind mitigation of impacts to aquatic winter flounder habitats, Weaver's Cove proposed that an "in-lieu" fee of $500,000 be established in a trust account administered by a state or Federal resource agency, or paid directly to a private natural resource management entity, for the purpose of providing compensatory mitigation for approximately 12 acres of aquatic resource impacts (including previously proposed subtidal fill).[5]

The amount of financial assistance proposed by Weaver's Cove in the May 20th mitigation plan was determined through the evaluation of three general mitigation scenarios commensurate with dredging related impacts. During 2005, two mitigation proposals were made by Weaver's Cove, the second of which was based on a concept suggested by a Federal agency. Neither of

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[5] The use of in-lieu fees for the purpose of providing compensation for adverse impacts to aquatic resources is consistent with other USACE Individual Permits (see Special Condition #16 in the USACE permit for the Hubline project) and USACE regulatory guidance letters.

these plans were accepted by the agencies, thus Weaver's Cove has proceeded to develop a third and hopefully final, plan.

It is understood that the USACE will schedule further coordination meetings with the resource agencies to advance this mitigation plan to the same level of detail as described in the shellfish mitigation plan described above.

The current winter flounder habitat mitigation program includes three elements, all of which will mitigate the potential loss of spawning habitat by strengthening the winter flounder stocks in Narragansett Bay. The plan includes 1) planting or re-establishing several acres of eel grass beds in Narragansett Bay, 2) direct restocking of winter flounder, and 3) expansion of the salt marsh/inter-tidal habitat restoration program at the southern end of the Project site. Items 1 and 2 would be funded by the previously proposed $500,000 account. Item 3 would be accomplished by Weaver's Cove as an incremental addition to the program.

5. Long Term Mitigation to Improve and Expand Anadromous Fish Spawning Habitat

As part of this Balanced Dredging Mitigation Program, Weaver's Cove is introducing a new element to the overall mitigation package. In lieu of severe or extensive restrictions to eliminate any possibility of short term impacts to passing anadromous fish, which restrictions are of uncertain value to the resource, the Project is proposing to fund measures that would clearly benefit the Taunton River anadromous fishery resources for the long term. More specifically, MDMF has identified a series of possible fish ladder improvements, fish ladder construction, removal of dam remnants, and removal of small dams and other obstructions (see Technical Report TR-15). According to MDMF, such measures would reopen significant spawning areas in the upstream tributaries of the Taunton River, spawning areas which are very important to the long term strength of the Taunton River anadromous fishery.

As part of this balanced dredging mitigation plan, Weavers Cove is willing to fund such measures in the amount of $750,000. It is expected that funding would be made available to state agencies, advocacy groups and /or local government bodies; these agencies or entities would be tasked to and would be responsible for implementing the measures.

III. CONDITIONS OF PROPOSAL

This Proposed Balanced Dredging Mitigation Plan reflects a balance of science issues, costs and timing, and has been developed based on, and is contingent on, a number of assumptions. Of course, should any of those assumptions be altered, this Proposal may need to be reviewed and/or modified.

A. First, this Proposal is based on the key assumption that all suitable dredged material will be disposed of offshore. While two dredge disposal alternatives remain under consideration by Weaver's Cove, the Project's strongly preferred alternative is to dispose of all suitable dredged material offshore in Federal waters at the Rhode Island Sound Disposal Site ("RISDS") and/or the Massachusetts Bay Disposal Site ("MBDS"). The EPA and the USACE have determined that all of the tested material meets the criteria for acceptability for ocean disposal as described in Sections 227.6 and 227.27 of the Ocean Dumping Regulations, and is suitable for unrestricted ocean disposal at either location under EPA Region 1/ USACE-NAE (2004) guidance. More than 2,500,000 cy of the 2,600,000 cy planning volume was covered by this determination. In a subsequent comment letter to the USACE, EPA has indicated that ocean disposal of dredged material versus upland disposal is environmentally preferable in this instance, because it will reduce the duration of the dredging as compared to the original proposal.

An additional Sampling and Analysis Plan ("SAP") for sediments located in the vicinity of the existing wooden pier (approximately 3% of the total sediments to be dredged) was submitted to the USACE on April 24, 2006 and remains under review. Depending on the results of the SAP, this material will either be disposed of offshore with the other material, or disposed of at an appropriate upland site (other than the LNG terminal site).

This plan would need to be modified if the Project's secondary disposal alternative proposal of using stabilized dredged material as engineered fill to develop the LNG terminal site in Fall River were to once again become the primary alternative. This alternative has been the subject of significant criticism by the Massachusetts Department of Environmental Protection, as well as by other commentors.

B. Second, this Balanced Dredging Mitigation Plan Proposal necessarily is based upon the key assumption of agency concurrence with the plan, including concurrence with the issuance of necessary permits that reflect this plan. In other words, it is understood that Weaver's Cove, NOAA Fisheries, FWS, NPS, EPA and USACE would no longer advance any positions, whether new or previously taken in written comments, to the extent that such positions are inconsistent with the resolutions reflected in this Proposal. For example, as part of this Proposal, NOAA Fisheries, FWS, NPS, EPA and USACE will not object to Weaver's Cove's ongoing efforts to secure approval for the ocean disposal of dredged material at designated sites in federal waters (RISDS and/or MBDS), consistent with the suitability determination by the USACE and the EPA that the material is deemed suitable for ocean disposal. In that regard, it is further understood that NOAA Fisheries, FWS, and NPS will accept the EPA-prepared October, 2004, RISDS FEIS as full and complete documentation of the potential environmental effects of offshore disposal at the RISDS of all sediments found to be suitable by the USACE and the EPA.

C. Neither NOAA Fisheries, FWS, nor NPS will oppose the issuance of a USACE dredging permit to Weaver's Cove by the USACE that incorporates such approval of offshore disposal.

For its part, Weaver's Cove commits that it will finalize, in good faith consultation with NOAA Fisheries, FWS and NPS, via the USACE permitting process, the mitigation plans discussed in Section II above.

Weaver's Cove looks forward to meeting with the relevant agencies and working toward a comprehensive plan along the lines set forth above.